Pipelining in '54

the OIL AND GAS JOURNAL

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PRICE 50 CENTS TABLE OF CONTENTS ON PAGE 1 **SEPTEMBER 20, 1954**

Manifolds ARE THE PROVING GROUNDS *for* ROCKWELL-Nordstrom VALVES

In large manifolds, the superiority of Rockwell-Nordstrom valves quickly becomes apparent. Large numbers of Rockwell-Nordstrom valves, sometimes in company with other types of valves, are installed on lines that are operated frequently. It's easy to compare Nordstrom's trouble-free performance with that of ordinary non-lubricated valves.

Field testing of this kind is the best salesman Rockwell has. It proves that Nordstrom valves, with their exclusive system of pressurized internal lubrication, seal more tightly, last many years longer and operate more easily than any other type of valve.

Take a tip from manifold operators who have judged the performance of hundreds of valves. Install Nordstrom. For additional information on Nordstrom valves, write: Rockwell Manufacturing Company, Pittsburgh 8, Pa. *Canadian Licensee: Peacock Brothers Limited*

ROCKWELL-Nordstrom VALVES

Lubricant-Sealed for Positive Shut-Off

the OIL AND GAS JOURNAL

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In Brief . . .

This year's pipeline issue is divided into four parts as follows:

• FLOW ANALYZERS . . . A 12-page article outlines a new, rapid procedure for making gas-flow calculations. Charts and examples are used to illustrate graphical solutions to all types of gas flow problems. Six liquid-flow charts can be used for obtaining quick, accurate solutions to gathering-system hydraulic problems. Tipped into the issue is a removable insert containing two handy charts, the gas-flow analyzer and the oil-flow analyzer. You can use these charts to solve your own line-flow problems.

• OPERATIONS SECTION . . . Here are a number of articles which feature the new ideas and practices currently being used in operating pipelines. They cover such widely different subjects as maintenance, revamp, metering, storage, more profit per unit of investment, and inert gas removal from pipeline gas.

• PIPELINE CONSTRUCTION . . . New construction practices are being applied on active projects throughout the country. Advanced pipe-laying methods, radiographic inspection of welds, and use of high-pressure air for testing and cleaning are some of the subjects covered in this section. Other new ideas are brought out in the discussion of the Lakehead and Cities Service lines.

• INSTRUMENTATION AND CONTROL . . . Techniques of automatic control for pipeline application are being rapidly advanced. Articles cover this field from remote tank gaging and level-alarm controls to unattended stations.

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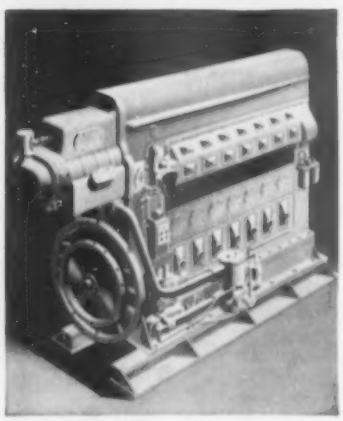

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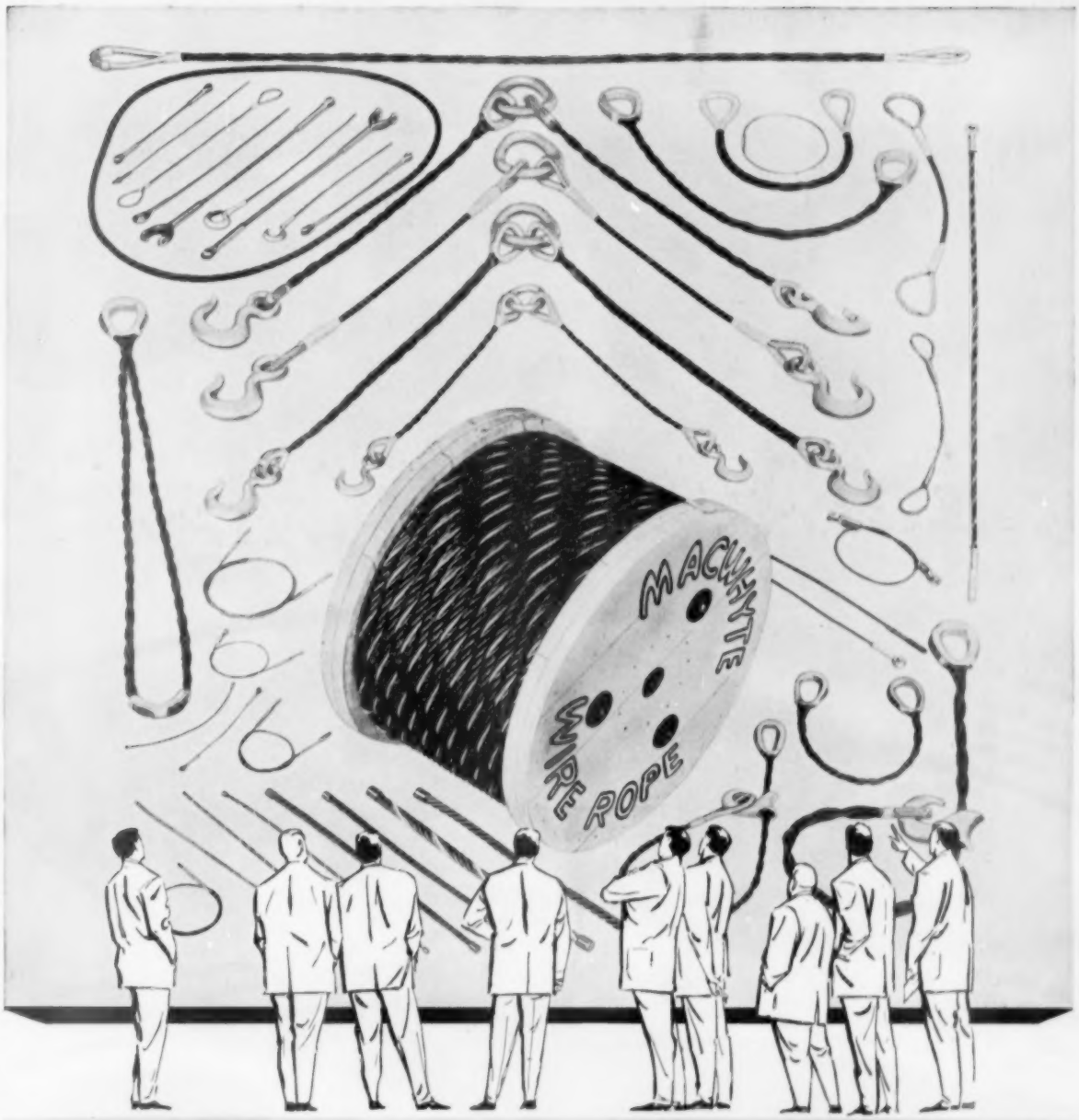

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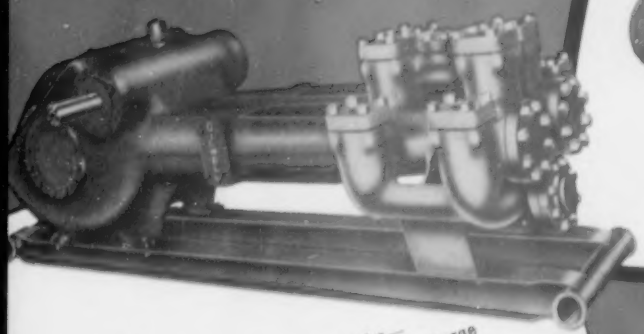

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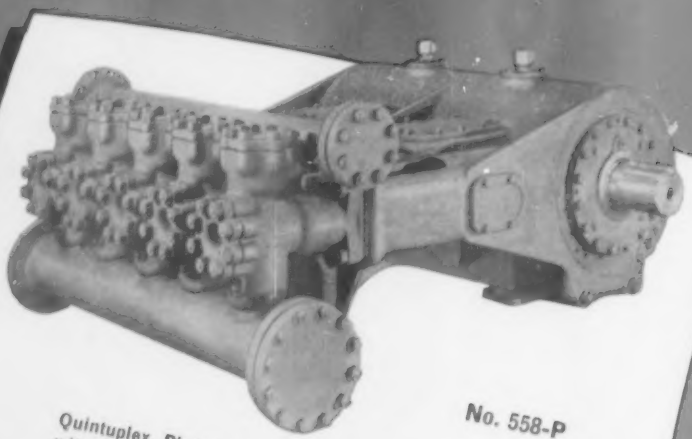

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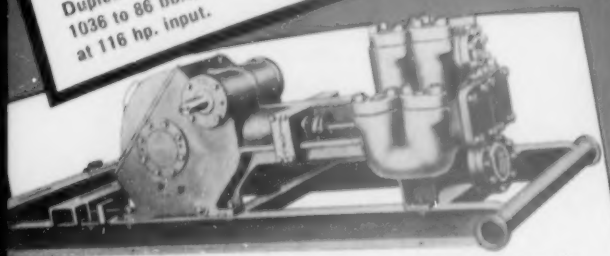

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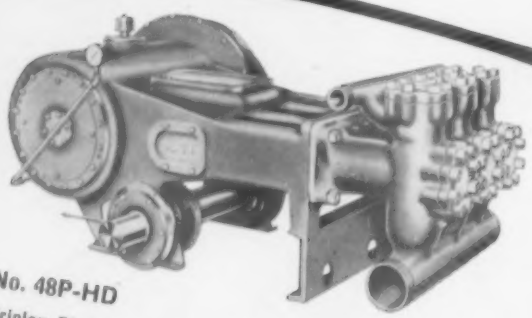

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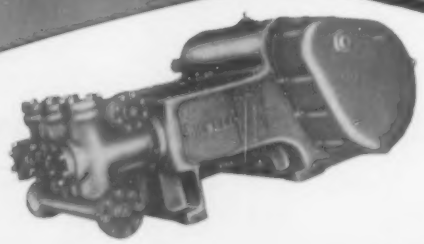

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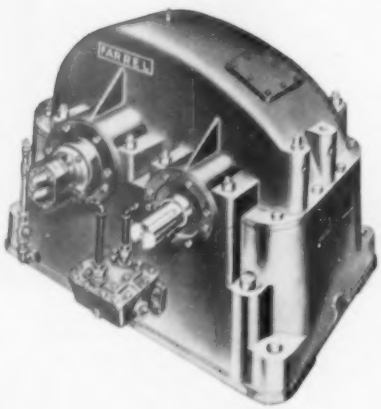

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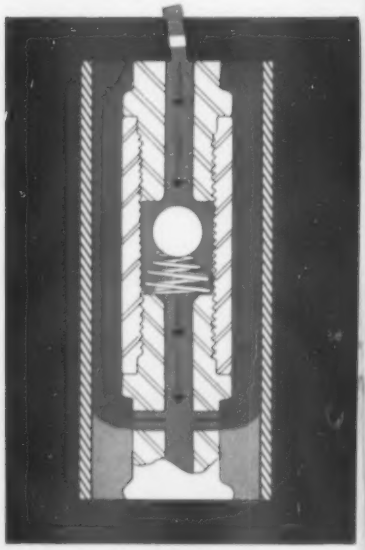

Schematic drawing illustrates flow pattern of injected fluid through hollow rod and check valve, out pony rod perforations and into the production annulus.

Send for folder #5402-P giving complete technical data including sizes, chemical and physical properties; load factors.

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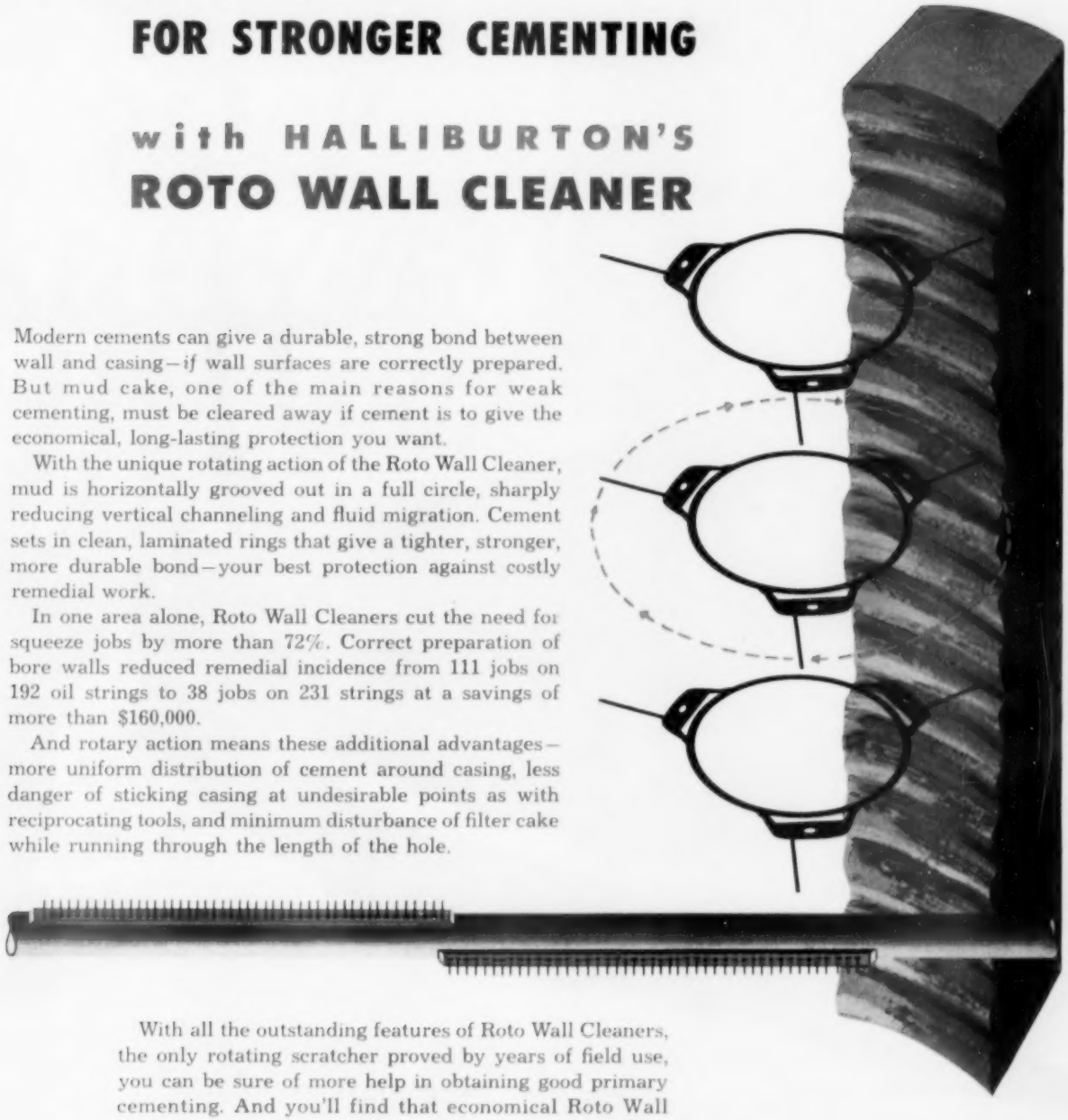

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TUBE-TURN Full-Encirclement Saddle improves "hot-tapping" of piping

SAFER, STRONGER "hot taps" are now made possible by the TUBE-TURN Full-Encirclement Saddle shown above. This new product is the first of a group of important developments of Tube Turns' unique pulsation pressure testing program.

Split longitudinally on a horizontal plane, perpendicular to the axis of the outlet, this new "hot tapping" reinforcement eliminates welds in the critical crotch area. Its installation requires a minimum amount of field welding. When used with high yield strength pipe, no welds are required between saddle and line pipe.

The TUBE-TURN Full-Encirclement Saddle is designed for high yield strength thin-wall pipe and for heavy wall cylinders used for headers, bottles and pulsation dampeners. It can be supplied for pipe sizes through 42", any outlet size, in composition and wall thickness to match service conditions.

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1. *Weld branch outlet pipe to run pipe according to normal procedure.*
2. *Position and block up bottom half of full-encirclement saddle.*

3. *Slip top half of full-encirclement saddle over branch outlet. Bring two halves together tightly by means of clamp such as shown.*

4. *Tack weld longitudinal lap plates to top half of saddle, remove clamp and complete welding of plates. (Plates are shop-welded to bottom half).*

5. *Fillet weld saddle outlet to branch pipe.* 6. *Join branch pipe to* TUBE-TURN *Welding Neck Flange. Normal tapping procedure follows.*

NOTE THAT when used with high yield strength, thin-wall pipe, as shown above, circumferential welds between saddle ends and run pipe are not required. This precludes possibility of failure due to underbead cracking or to local stress concentrations which exists at such attachment welds with conventional saddles or other types of "hot tap" fittings which must be fillet welded to high yield strength, thin-wall pipe. The TUBE-TURN Full-Encirclement Saddle fully meets all requirements for reinforcement of welded branch connections as developed by Section 8 of the Code for Pressure Piping.

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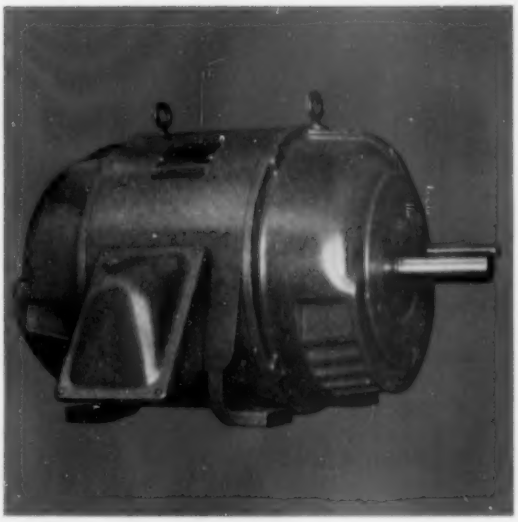

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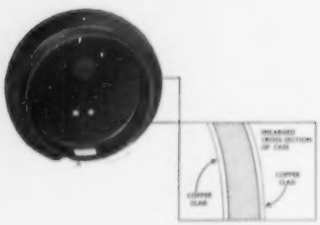


Another first for Marsh

Here is a case in keeping with the "Conoweld" tube. Another recent Marsh development, it is called the

New *Marshalloy* Case

It is a copper-clad wrought steel case of boiler plate thickness, four times as strong, and one-third lighter than conventional cast iron cases. Copper surface makes it as non-corrosive as a plastic or die-cast case. Handsome, corrosion-resistant, satin black enamel and Marsh safety blow-out plug are the finishing touches.

Here is one of those typically MARSH developments . . . the kind of pioneering step you have come to expect from the organization that originated the basic advances in pressure gauges culminating in the exclusive "Recalibrator." This latest Marsh development is known as the

NEW MARSH *"Conoweld"* TUBE

This time we have made the best part of the best Marsh gauge still better. We have gone into the part that actually does the work — the socket and tube — and have made it permanently leak-tight from inlet to tip of tube.

We have done this by fusing the tube into the socket and the tip to the tube so that the whole assembly is truly *one piece*. The photo of one of the sockets sawed in half shows the perfect fusion of the vital joint. Tests and photomicrographs prove the perfection of the fusion.

Developing the fusing process called for extensive research. The method as finally perfected — the "Conoweld" process — involves first fusing the tube to the socket and end-piece; then tempering the tube to required resiliency.

Yes, it is these dramatic departures from beaten paths that have achieved leadership for Marsh gauges and are ever increasing that leadership. Ask for latest information covering gauges for all services.

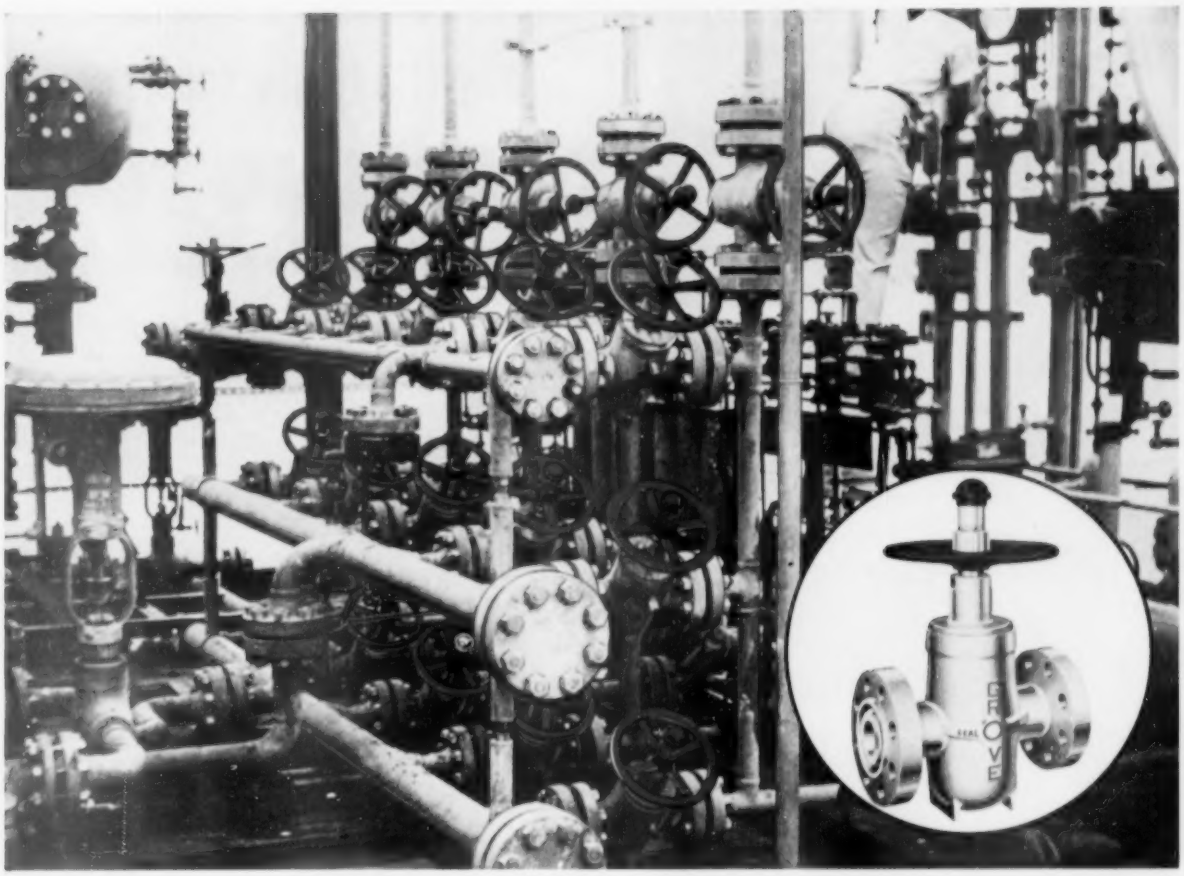
MARSH INSTRUMENT CO. *Sales affiliate of Jas. P. Marsh Corporation* **Dept. L, Skokie, Ill.**

HOUSTON BRANCH PLANT: 1121 Rothwell St., Sect. 15, Houston, Texas

MARSH GAUGES

"THE STANDARD OF ACCURACY"

MANUFACTURERS OF THERMOMETERS • WATER REGULATING VALVES • SOLENOID VALVES • HEATING SPECIALTIES



Grove Seal-"O"-Ring Gate Valves replace other valves at Red Fish Bay installation

The photograph above shows a portion of one of three flow manifold platforms at Red Fish Bay. This one was originally equipped with Grove Seal-"O"-Ring Gate Valves, which performed without leak or maintenance even from the very first, when subjected to the mud and sand carried up by the initial flow of gas.

Competitive valves on the other two platforms soon failed under similar operating conditions. As their replacement rapidly became necessary, Grove Seal-"O"-Ring Gate Valves were installed because of the performance record established on the first platform.

Now, after over a year, every one of the Grove Seal-"O"-Ring Valves on all three platforms is operating freely with dead-tight seal. There has been no maintenance—no parts replacement—and no greasing on any of the Grove Valves since they were installed! This is but one of many installations that have proved Grove Seal-"O"-Ring Valve superiority.

Available through leading oil field supply stores

405

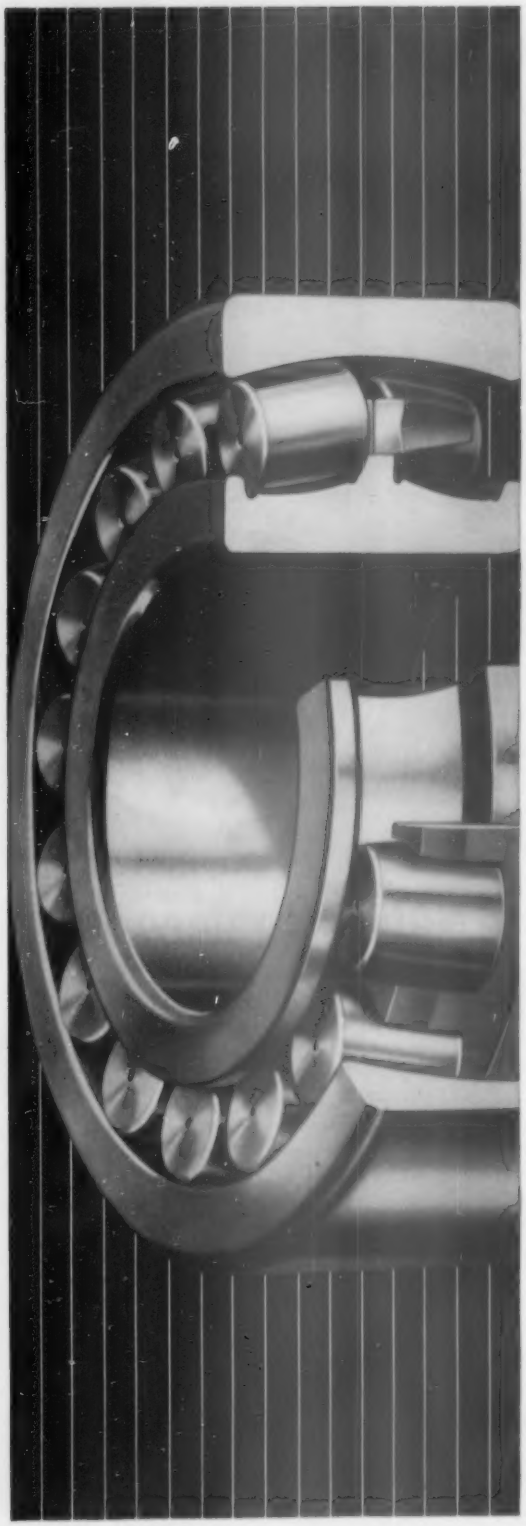
GROVE SEAL-"O"-RING Gate Valves

GROVE REGULATOR COMPANY • 65th & Hollis Sts., Oakland 8, California

HOUSTON 4—1901 Calumet St. • **LOS ANGELES 6**—1930 W. Olympic Blvd. • **NEW YORK 17**—415 Lexington Ave.

GROVE
SIMPLICITY
ACCURACY
SAFETY

CORPUS CHRISTI, TEXAS	ODESSA, TEXAS	TULSA, OKLAHOMA	LAFAYETTE, LA.	NEW ORLEANS, LA.	DENVER, COLO.
4534 No. Baldwin Blvd.	114 N. Washington St.	318 Thompson Bldg.	Scott Road	504 Delta Bldg.	2669 Cherry St.



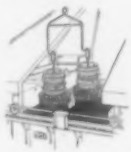
why it pays to specify

TORRINGTON

Spherical Roller Bearings

Uniform, close control of precision-ground contact surfaces—for even load distribution and maximum bearing life.

Accurate geometrical conformity between races and rollers—for ultimate load carrying capacity and performance.



Races and rollers heat treated according to the most advanced metallurgical procedures—for maximum durability.

Individual one-piece cage for each path of rollers—assures freedom of operation.

Integral flange on inner race—to give radial stability and positioning for thrust loads—both essential to satisfactory performance.

Self-aligning—for continuous, free-rolling service under shock loads and at sustained speeds.

Unit assembly—for easy, economical handling.

Available from stock with either straight or tapered bore—for shaft or adapter mounting.

These are advantages that give you long, efficient, low-maintenance service in the toughest heavy-duty application. **To get maximum value for your bearing dollar,** ***specify TORRINGTON Spherical Roller Bearings.***

THE TORRINGTON COMPANY

South Bend 21, Ind. • Torrington, Conn.

TORRINGTON *SPHERICAL ROLLER* **BEARINGS**

Spherical Roller • Tapered Roller • Cylindrical Roller • Needle • Ball • Needle Rollers

SALT WATER INSIDE, TRAFFIC VIBRATION OUTSIDE—REINFORCED PLASTIC PIPE STAYS ON THE JOB

Salt water disposal lines run under the streets in Oklahoma City, where wells are located within the city limits. When steel pipe corroded, it was replaced by cement-asbestos pipe. After a few months, traffic vibration caused failure, and the streets had to be torn up again.

In September, 1951, 4½ in. O.D. "Fibercast" Thermosetting Reinforced Plastic Pipe was installed. It has remained in continuous, trouble-free operation ever since. Its BAKELITE Polyester Resin—glass-fiber construction is highly inert, mechanically strong, and shock-resistant. Corrosion and vibration problems are gone.

The same "Fibercast" pipe can carry gas, hydrogen sulphide-laden crude oil, and acid muds—needs no coating, wrapping, or cathodic protection. Its inner surface stays smooth, minimizing paraffin build-up, providing greater flow, and permitting the use of smaller diameters. Flow is even, with settling, surge, and back pressure reduced.

A 20-foot length of "Fibercast" pipe is light enough for one man to lift alone. Installation is fast, handling costs are low. Since the BAKELITE Polyester Resin is thermosetting, heat won't soften it. The pipe won't shatter, yet a hacksaw cuts it easily. Fittings and couplings for "Fibercast" pipe are also made of glass fibers and BAKELITE Polyester Resins, and have the same features.

"Fibercast" thermosetting reinforced plastic pipe is made by **Fibercast Corporation**, Sand Springs, Okla., and distributed by the **Youngstown Steel Products Co.**, **The Continental Supply Co.**, and **Youngstown Steel Products Co.** of California.

BAKELITE

TRADE-MARK

POLYESTER RESINS

TRADE (B) MARK

BAKELITE COMPANY

A Division of
Union Carbide and Carbon Corporation

30 East 42nd Street, New York 17, N. Y.

In Canada: Bakelite Company
Division of Union Carbide Canada Limited
Belleville, Ontario

Get Complete BALANCE

—FOR HIGH SUSTAINED ACCURACY AND LOW MAINTENANCE IN ALL METERING OPERATIONS

Only with Brodie exclusive balanced performance can you get the most from petroleum product measurement.

EXCLUSIVE STATIC AND DYNAMIC BALANCE

Only Brodie BiRotors are *designed* for static and dynamic balance to minimize vibration and bearing-load at all operating speeds – with no reciprocating parts or vanes.

BALANCED SIMPLICITY, DESIGN COMPACTNESS

Just two moving parts with simple rotary motion in measuring chamber allow compact design for clean installations, easy flexibility of piping arrangements.

BALANCED UNIT-BUILT ASSEMBLIES

Just 4 unit-built assemblies, accessible or removable for cleaning without disturbing piping connections. Double-case construction means that no piping strains can distort measuring element.

BALANCED FLOW CHARACTERISTICS

Simple direct flow-lines with smooth, continuous, non-pulsating delivery, assure high thru-put with top efficiency of pressure system.

Not only for pipeline service – but wherever petroleum products are handled – Brodie BiRotors consistently measure with high sustained accuracy and extremely low maintenance or downtime. No single factor has been over-emphasized, minimized or sacrificed at the expense of any other. And there's a BiRotor model for every petroleum metering need. Investigate fully today.

BRODIE BiRotor METERS

ALL-STEEL TRUE-ROTARY

RALPH N. BRODIE COMPANY · San Leandro, California, U.S.A.

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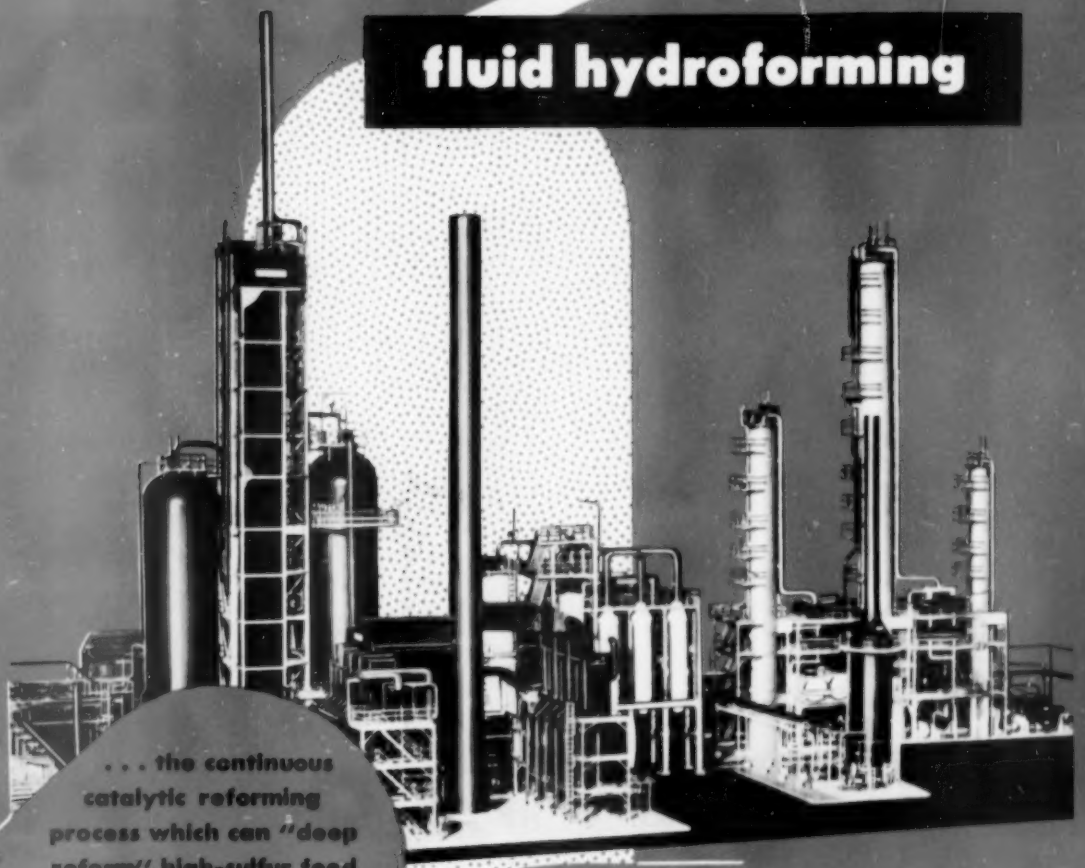
REPRESENTATIVES WITH STOCKS AND SERVICE FACILITIES IN ALL PRINCIPAL CITIES

fluid hydroforming



. . . the continuous catalytic reforming process which can "deep reform" high-sulfur feed stocks without rapid catalyst deterioration.

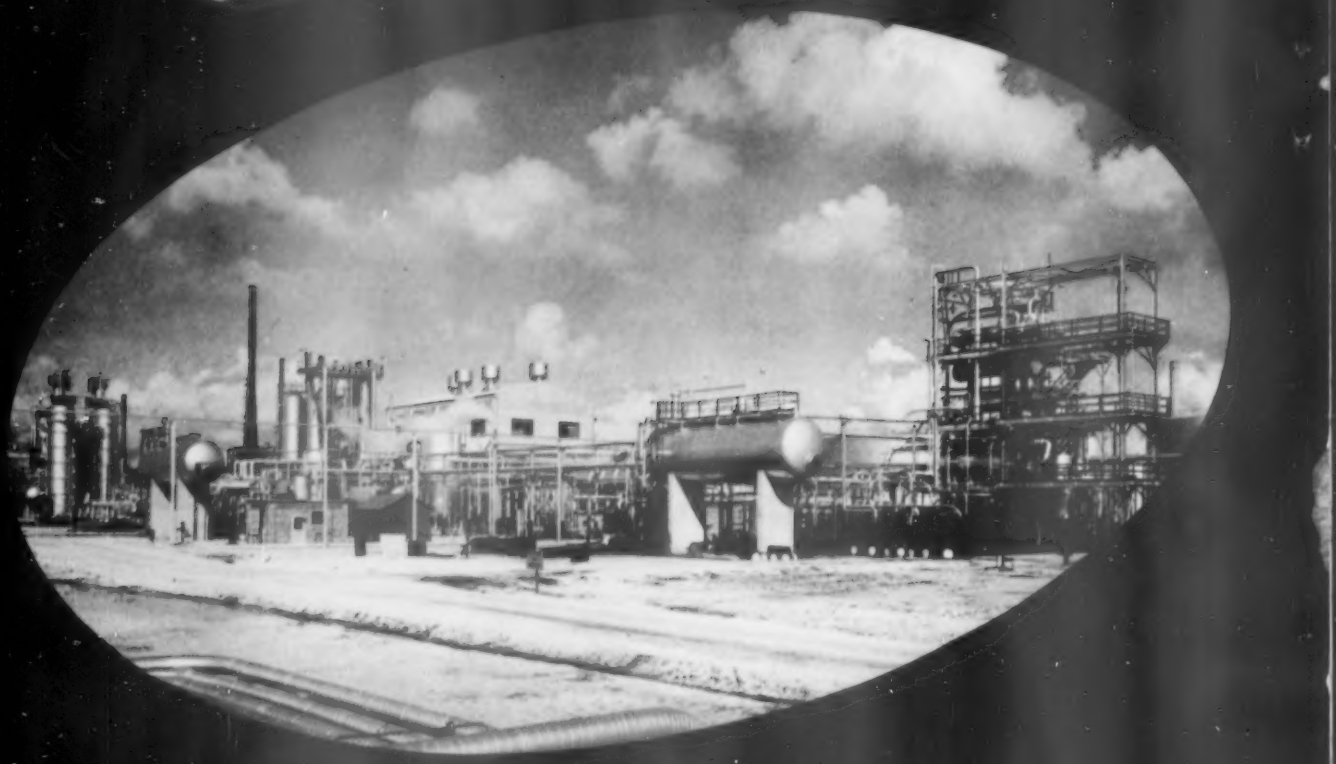
Now, the model . . . and in early 1955 . . . the completed plant:—the Fluid Hydroformer now being built by Foster Wheeler for the Creole Petroleum Corporation.

This Fluid Hydroformer is part of an expansion program at "Creole's" Amuay Bay, Venezuela refinery for which Foster Wheeler is the main contractor; also included are a 75,000 bbl/day Crude Distillation unit, a Naphtha Fractionation-Stabilization unit and extensive offsite facilities.

FOSTER WHEELER

165 Broadway,
New York 6, N. Y.

modern design and its realization



the Fawley lube plant

Designed and constructed by Foster Wheeler, in collaboration with the engineering department of the Standard Oil Development Company, this plant, comprising Propane Deasphalting and Dewaxing, Phenol Solvent Refining and Clay Contact Rerun units, is daily turning out superior lubes for British industry.

FOSTER WHEELER

THESE EXCLUSIVE PRECISION-MACHINED GUIDES

eliminate chatter

lengthen service life

IN LUNKENHEIMER

IRON BODY GATE VALVES

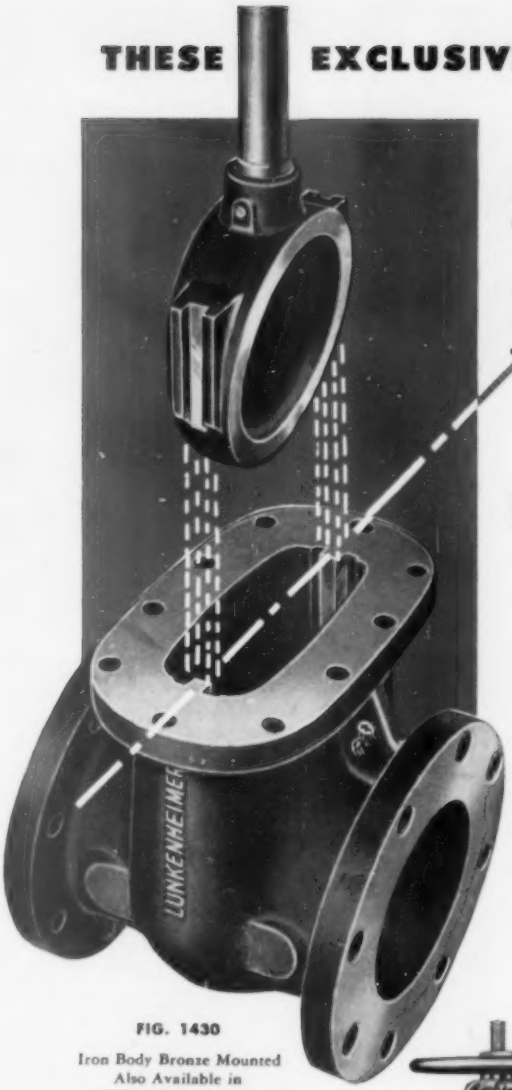
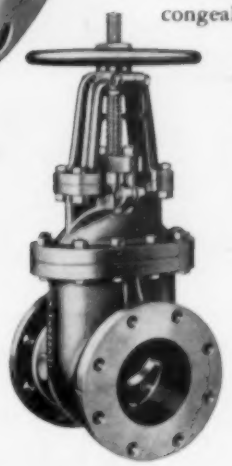


FIG. 1430

Iron Body Bronze Mounted
Also Available in
FIG. 1576 and 1578
All Iron
Screwed and Flanged Types
Fig. 1578N-4
3% Nickel Iron with
18-8 Mo (Type 316) Stainless Steel Trim

Gate valve chatter — the sound of wasteful, accelerated wear — is eliminated by Lunkenheimer's unique method of manufacturing Iron Body Gate Valves. Not only are the guide channels in the disc accurately machined, but the guides in the body as well. These precision-machined guides hold the disc firmly in line — prevent pressure from forcing the disc against the opposite seat. Result: no clatter, no chatter, and much longer valve life. The complete Lunkenheimer Iron Body Gate Valve line includes 3% Nickel Iron Gate Valves (Fig. 1578N-4) designed especially for mildly corrosive service in the oil, paper, and chemical processing industries. They have 18-8 Mo (Type 316) Stainless Steel and Monel Trim to protect the seating faces. All Lunkenheimer Iron Body Gate Valves feature solid discs without pockets that might trap congealing substances in the line. They also have handy swing-bolts and shelves that make repacking easy — are ideal for service in the chemical, petroleum, and pulp processing fields.



WRITE FOR Circular 564, describing the complete Lunkenheimer Iron Body Gate Valve line. Address: The Lunkenheimer Co., Box 360F, Cincinnati 14, Ohio, or phone your Lunkenheimer Distributor.

LUNKENHEIMER
L
QUALITY

IRON • STEEL • BRONZE

LUNKENHEIMER®

THE ONE *Great* NAME IN VALVES

L-253-99

For Rugged Power Uses Exclusively

4 MODELS
4 and 6 CYLINDERS
.403 TO .559 Hp / CU. IN. DISPL.

"JOHN" WILLYS *

Engine Chalk Talk

I wanted to be one of the first to let you know that we at Willys have designed four POWER GIANT Engines just for industrial uses. They're based on proven designs . . . with "proven-in-action" features known for ruggedness from the Arctic to the Tropics. And, they incorporate the same low maintenance, high efficiency characteristics of all Willys designs. As for torque and power, the POWER GIANTS are right up top in their weight and displacement class. For rugged power needs, investigate these POWER GIANTS.

* Design Department, Willys Motors, Inc.

Willys **POWER GIANT** Industrial Engines and Power Units

INDUSTRIAL ENGINES and POWER UNITS

Model	Cyl. and Head	Displ. Cu. in.	Range Max. bhp	Range of speed
Jeep	4 L	134.2	22 - 60	1200 - 4000
Hurricane	4 F	134.2	22 - 70	1200 - 4000
Lightning	6 L	161.0	28 - 75	1200 - 4000
Giant Hurricane	6 F	161.0	28 - 90	1200 - 4200

SEND FOR POWER GIANT BULLETINS
4 Cylinder Engines
6 Cylinder Engines
Power Units

PROVEN IN ACTION

DISTRIBUTORS: unusual sales opportunities available. Write today.

WILLYS MOTORS, INC. *Industrial Engine Department*

Assemble Aeroquip Hose Lines Right in the Field...

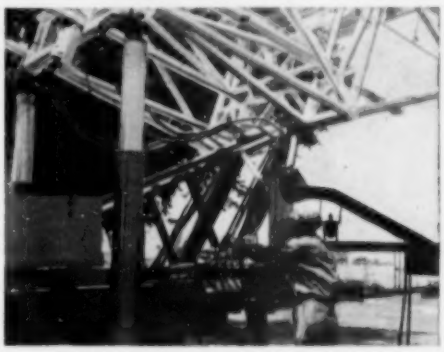
IN MINUTES!

Quick Replacement of Fuel, Lube, Air and Hydraulic Lines Keeps Equipment on the Job!

The difference between minimum downtime and wasted hours often depends upon the speed with which a damaged fuel, lube, air, or hydraulic line can be replaced. If you operate mobile equipment, Aeroquip bulk hose and detachable, reusable fittings will provide a compact, portable inventory that meets all your hose line replacement needs.

You can make assemblies on the spot by cutting bulk hose to required length and attaching the reusable fittings. This "Aeroquip Idea" gets equipment back on the job *fast*. For information, see your Aeroquip distributor or write us.

This new Franks Manufacturing Corporation Jet 43 trailer-mounted drilling rig is the last word in mobility. Flexible plumbing holds rig-up and rig-down time to a minimum.



The derrick on this Franks rig is raised and extended hydraulically. Aeroquip hose lines are used because they are durable, weather-resistant and they simplify user replacement problems.

President Carl White, Jr., of Franks Manufacturing Corporation (right) points out to H. E. Stanfield, purchasing agent, some of the advantages of Aeroquip detachable, reusable fittings that are used on Franks drilling units.

Aeroquip

REG. TRADE MARK

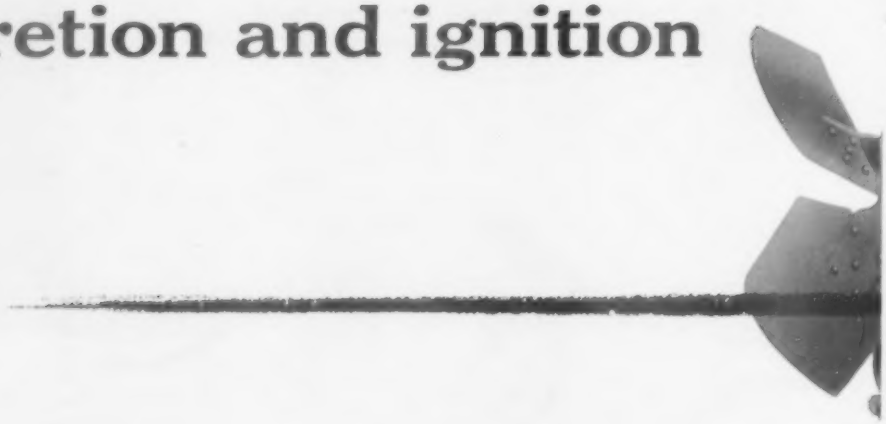
AEROQUIP CORPORATION, JACKSON, MICHIGAN

SALES OFFICES: Burbank, Calif. • Dayton, Ohio • Hagerstown, Md. • High Point, N. C. • Miami Springs, Fla. • Minneapolis, Minn. Portland, Ore. • Van Wert, Ohio • Wichita, Kan • **IN CANADA:** Prence Progress and Engineering Corporation Ltd., Toronto **IN ENGLAND:** Super Oil Seals & Gaskets, Ltd., Birmingham

AEROQUIP PRODUCTS ARE FULLY PROTECTED BY PATENTS IN U.S.A. AND ABROAD

Announcing...

revolutionary new diesel fuel system... as simple as gasoline carburetion and ignition



Exclusive PT Fuel System now standard on all Cummins Diesels

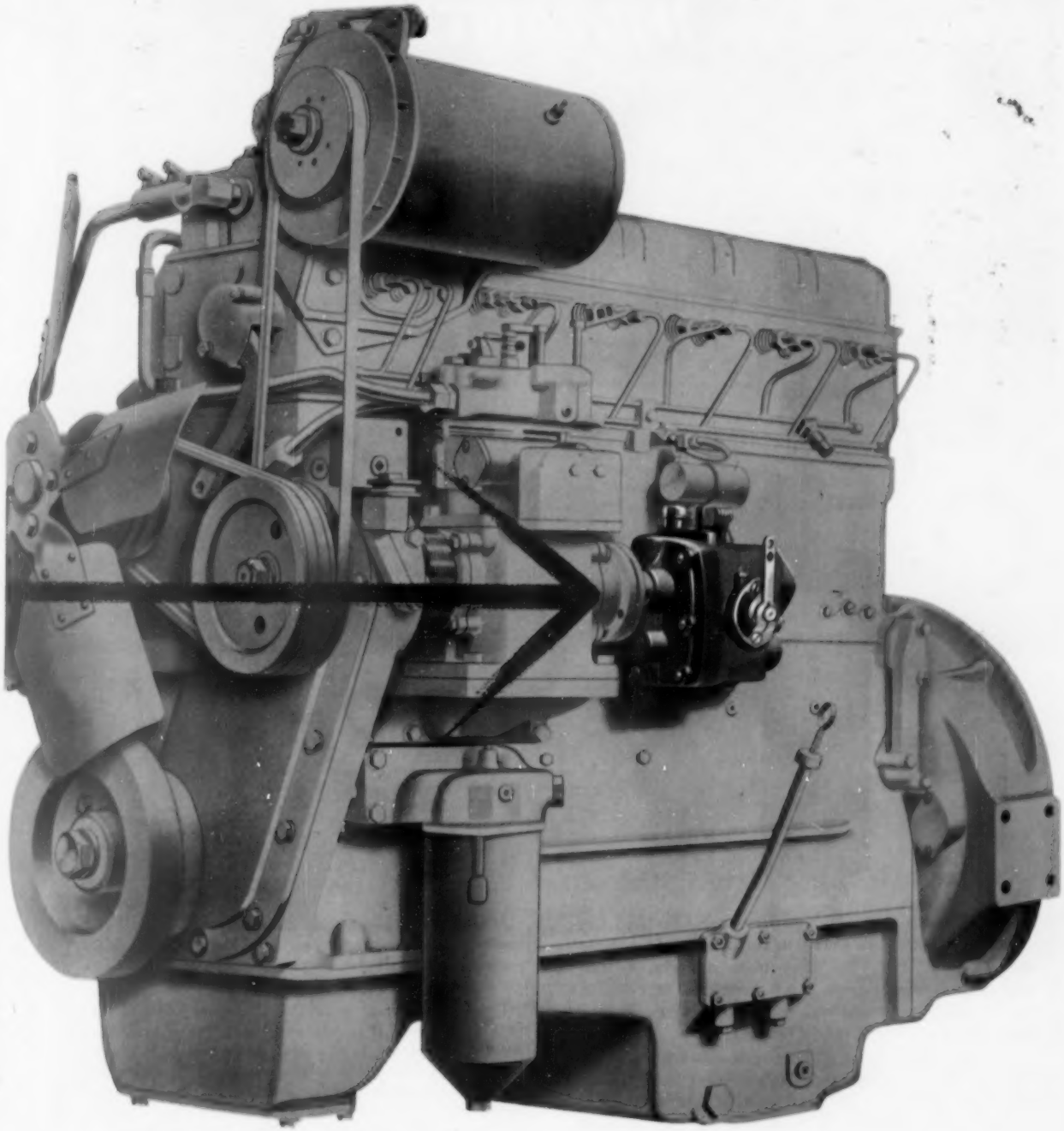
- Drastically reduces maintenance costs
- All mechanics can understand and service it
- Pump weighs only 13 pounds—system has no racks, check valves, metering plungers, discs, floats, etc.— does not have to be timed to engine
- Adaptable to all Cummins Diesels built since 1932

Write for your copy of descriptive folder "Cummins PT Fuel System."

CUMMINS **Cummins**

Engine Company, Inc., Columbus, Indiana

Leader in rugged, lightweight, high-speed diesels (60-600 h.p.)



AMERICAN-LAFRANCE

DRY CHEMICAL EXTINGUISHERS

When fire hits, these new American-LaFrance Dry Chemical models are ready to stop it. Simply pull pin and squeeze lever. No gadgets to operate, no last minute pressurizing from a gas cartridge or cylinder, no inverting, no bumping, no shut-off nozzle on the hose needed. They're ready to go!

Their fire-smothering efficiency is aided by a scientifically designed Discharge Nozzle which fans the Dry Chemical downward in wide pattern and with great density. Their 150 (plus 25 minus 0) psi. air (or nitrogen) pressure maintains uniform duration of the Dry Chemical discharge pattern.

A glance at valve gauge indicates whether unit is in operating order. When partially operated, the extinguisher can be left standing without loss of air pressure, for use on a possible reflash.

The American-LaFrance Dry Chemical Valve is completely new also. It is ruggedly built. No special tools needed. Contains few parts. Equipped with Safety Relief Valve. Complete valve and siphon tube assembly removes as a single unit for recharging. They're watertight, and corrosion resistant. Tested for vibration and for operation at temperatures from minus 40° F. to plus 150° F. A Moisture Trap provides for pressurizing with air. Write for free illustrated literature.

Approved by Underwriters' and Factory Mutuals Laboratories for Class B and C fires

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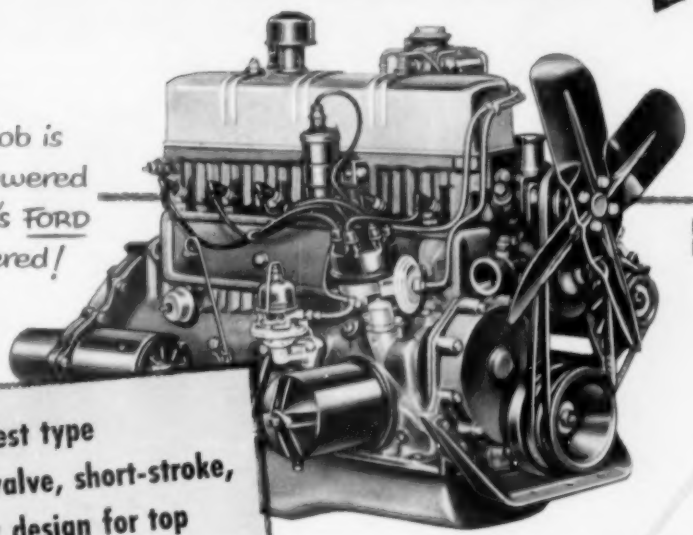
ALFCO

Introducing still another ULTRA-MODERN FORD "223" CU. IN. SIX-CYLINDER INDUSTRIAL ENGINE at a Low FORD Price

Your job is WELL powered when it's FORD powered!



Ford INDUSTRIAL ENGINES AND POWER UNITS

It's the latest type overhead-valve, short-stroke, deep-block design for top performance and economy.

This new engine is designed to outperform other internal combustion power plants of comparable displacement on the market today. And, coupled with its gas-saving economy is the fact that parts and service are available through Ford Dealers everywhere.

Remember, too, that Ford Sales Engineers are always glad to discuss your particular power problems and extend every help in solving them. Merely phone or write us.

CHECK THESE OUTSTANDING FEATURES:

Overhead valves for better fuel economy, while "free-turn" action prolongs valve life.

Large bore, short-stroke design with 7.2 to 1 compression delivers more power from less displacement.

Chrome-plated top compression rings reduce both piston ring and cylinder bore wear to prolong engine life.

Full-flow oil filter cleans all the oil on every trip through the engine. Bearings last longer, engine life increased.

Full-length water jackets promote uniform expansion of cylinder walls.

Four-bearing, counterweighted crankshaft is precision-balanced for smoother engine operation.

Deep design of engine block extends well below center of crankshaft for greater rigidity, quiet performance and extra long engine life.

A detailed descriptive folder of the Ford "223" Engine, giving complete specifications, power and torque curves, dimensional drawings, accessories available for specific applications, etc., will be sent you upon request.

INDUSTRIAL ENGINE DEPARTMENT
FORD MOTOR COMPANY
15050 Woodward Avenue, Highland Park 3, Michigan

PIPELINES

Through adequate store and warehouse stocks and prompt mill shipments, J&L makes important contributions to the construction and maintenance of pipe lines throughout the United States and Canada.

CALL FOR J&L

J & L Line Pipe

J & L Wire Rope

Midwest Welding Fittings

Walworth Valves

Ladish Flanges

J&L STEEL

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STEEL CORPORATION
SUPPLY DIVISION — TULSA, OKLAHOMA
Serving The United States and Canada

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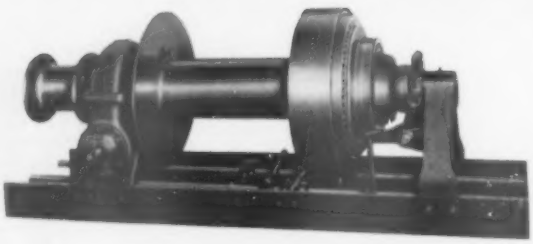
PIPE GINNING?

use a TULSA
FRICTION CLUTCH WINCH

Tulsa friction clutch winches are favorites of contractors, riggers, steel erectors, pipe line contractors and public utility companies. The three-disc friction clutch and automatic worm brake assembly make these winches ideal for logging, ginning pipe, setting poles, pile driving, and raising or lowering any load requiring smooth acceleration and deceleration.



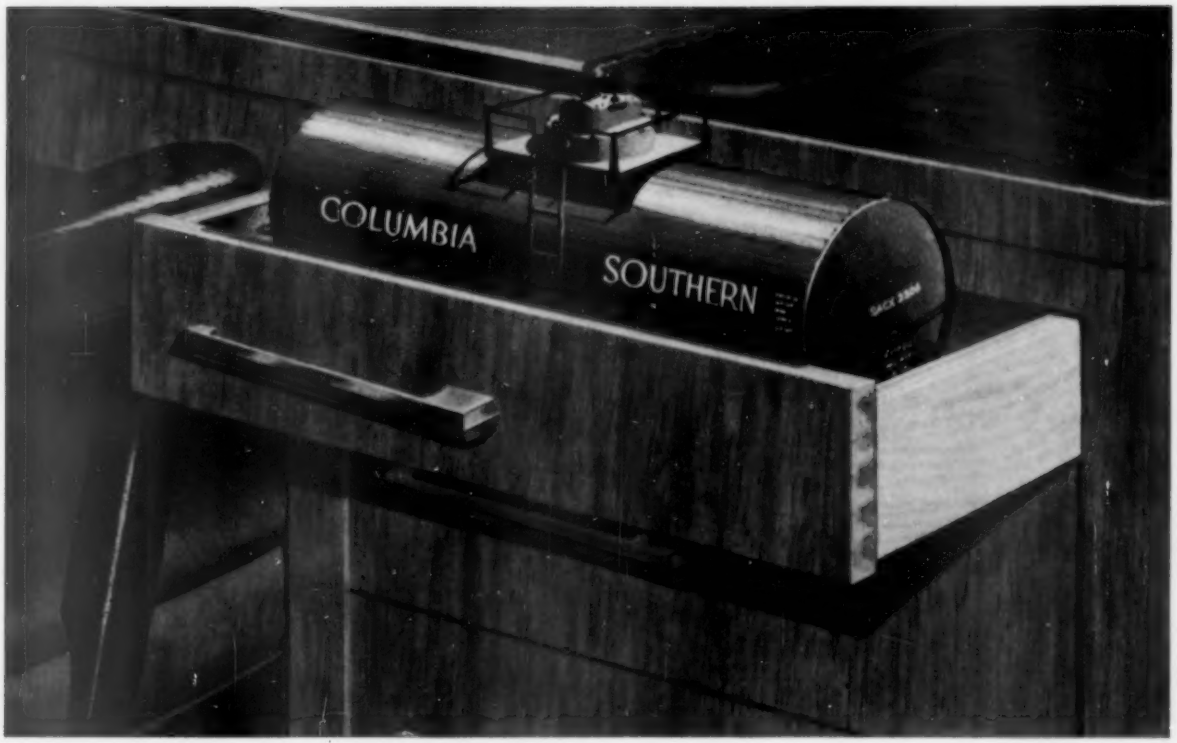
Whatever your winching requirements, there's a Tulsa Winch to do the job. Tulsa Winches are available in 28 different models, in capacities from 6,000 to 80,000 pounds and designed for use on all makes and sizes of trucks and crawler tractors.

For detailed information and prices, contact your nearest Tulsa Winch distributor or write direct to—

Tulsa* Winch
TULSA, OKLAHOMA
DIVISION OF VICKERS Inc.

*Reg. U. S. Pat. Off.

THE WORLD'S LARGEST MANUFACTURER OF TRUCK POWER WINCHES



A top-drawer idea for Caustic Soda users!

SAVE WITH 73%

The economics of buying 73% liquid Caustic Soda can be mighty profitable *to you*, if you are still purchasing 50% concentration.

Over the past few years, many of our customers have converted to the higher strength with highly satisfactory results. Our records show that . . .

- One customer saved $131 per car
- Another saved $1,179 the first year
- Annual savings of $35,100 were reported
- An 830% return was realized during the first 10 months

These figures are typical, and we believe they prove at least one thing: It pays to investigate the savings possible through buying the 73% concentration. That applies whether it has been your practice to dilute the Caustic Soda at your site, or whether you have been adding flake caustic to bring the 50% liquid to a higher strength.

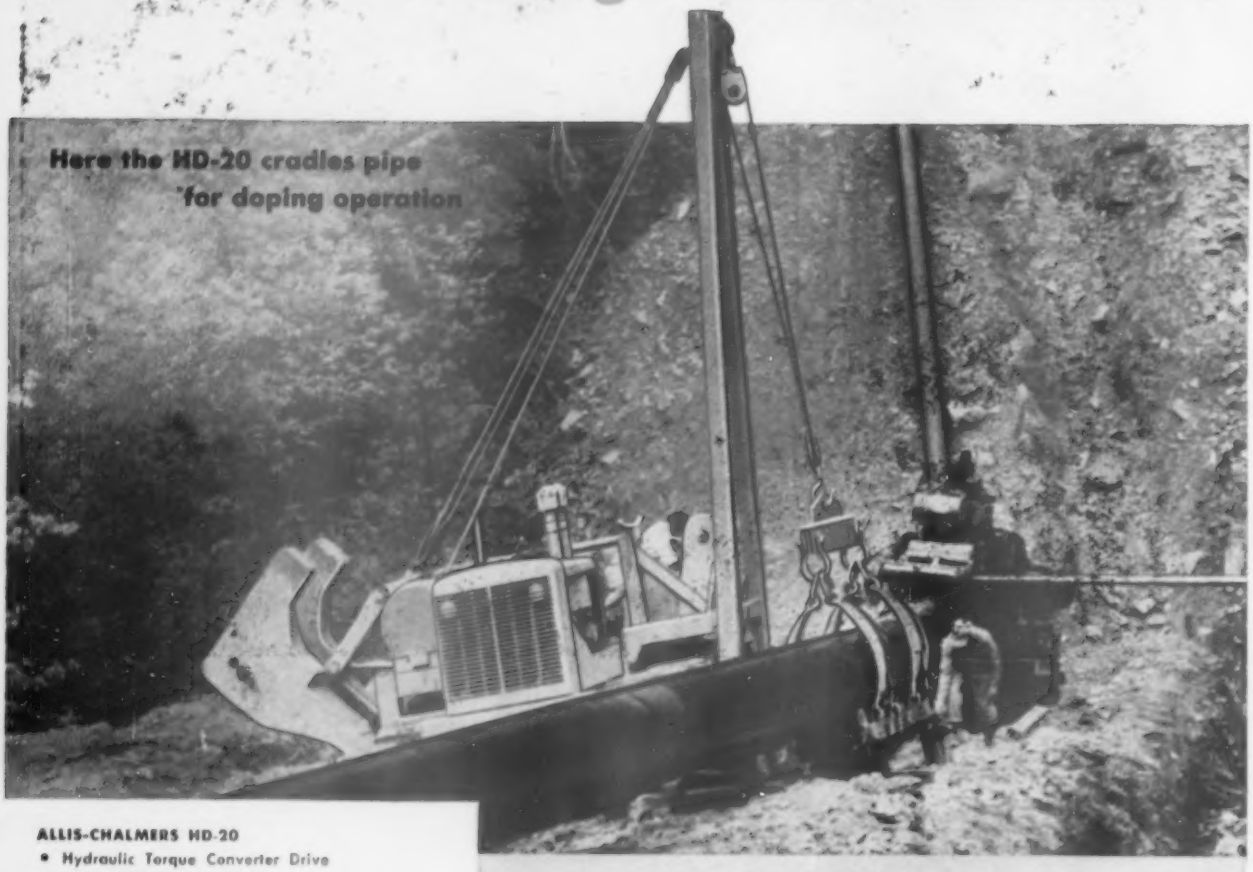
The amount of Caustic Soda you use, and the location of your plant influences how much you may save, but in either case, look into 73% right away.

If you need help in estimating your savings before you convert, just contact our Caustic Soda Department at the Pittsburgh office. Our staff will be glad to do the paper work for you. But do it today!

COLUMBIA-SOUTHERN CHEMICAL CORPORATION
SUBSIDIARY OF PITTSBURGH PLATE GLASS COMPANY
ONE GATEWAY CENTER · PITTSBURGH 22 · PENNSYLVANIA

DISTRICT OFFICES: Cincinnati • Charlotte • Chicago • Cleveland • Boston • New York • St. Louis • Minneapolis • New Orleans • Dallas • Houston • Pittsburgh • Philadelphia • San Francisco

there's a right Allis-Chalmers



Here the HD-20 cradles pipe for doping operation

ALLIS-CHALMERS HD-20

- Hydraulic Torque Converter Drive
- Boom tractor with standard counterweights — 71,650 lb
- Bare Tractor — 42,700 lb
- 175 net engine hp

Time and money-saving advantages like 1,000-hour lubrication periods for truck wheels, idlers, support rollers; oil-enclosed track release mechanism; all-welded box A-type main frame; true-dimension tracks give all three Allis-Chalmers side boom crawlers extra working hours, less down time. Extra long tracks and excellent balance provide stability and flotation to operate in mud and soft going. Double reduction final drives and smooth, clean bottom construction provide increased clearance to skim over obstacles that might otherwise hang up a tractor.

ALLIS-CHALMERS HD-15

STANDARD TRANSMISSION

- Boom tractor with standard counterweights — 50,050 lb
- Bare Tractor — 29,500 lb
- 109 drawbar hp

HYDRAULIC TORQUE CONVERTER DRIVE (optional)

- Boom tractor with standard counterweights — 50,500 lb
- Bare Tractor — 29,950 lb
- 135 net engine hp

HD-15 handling pipe for bending machine

Tractor-Side Boom Team for any size pipe, anywhere

Super inch, big inch, medium inch or small . . . whatever your pipeline job, there's an Allis-Chalmers tractor-side boom to handle it.

From dust bowls to swamp holes . . . in blistering deserts or windswept mountains, these modern, built-to-take-it tractors and matched side booms, provide work advantages that are boosting pipe footage, keeping tractor maintenance time and cost down.

Allis-Chalmers HD-20—20-ton powerhouse with liquid-smooth control

A big producer on all phases of pipeline work, the HD-20 is an outstanding favorite on cradling jobs. Here cushioned starts and steady control through built-in torque converter drive make it easy for operator to match tractor speed to cleaning-priming or doping-wrapping machines — even on steep hillsides. With torque converter eliminating most shifting, operator's hands are free to handle side boom controls.

Allis-Chalmers HD-15 — A standout before, does even more with torque converter drive

From the very first, the 29,500-lb HD-15 with standard gear transmission, performed beyond expectation on pipe laying, lifting, dozing and pulling jobs. Pipeliners are using it successfully on big and super-inch pipe previously handled by bigger, heavier machines. Now with optional hydraulic torque converter drive, it provides that precision control for cradling work plus greater forward speed, a faster reverse.

Allis-Chalmers HD-9—Right for smaller-inch pipe—a welcome addition on any job

This new, heavy-duty Allis-Chalmers HD-9 Tractor and side boom provides new strength, power and exceptional lifting capacity to handle a wide range of pipeline jobs. It's the right answer to construction of feeder, distribution and smaller-inch cross-country lines — ideal size on big-inch jobs for stringing, handling pipe for welders or bending machines — economical for maintenance, repair, and take-up on existing lines.

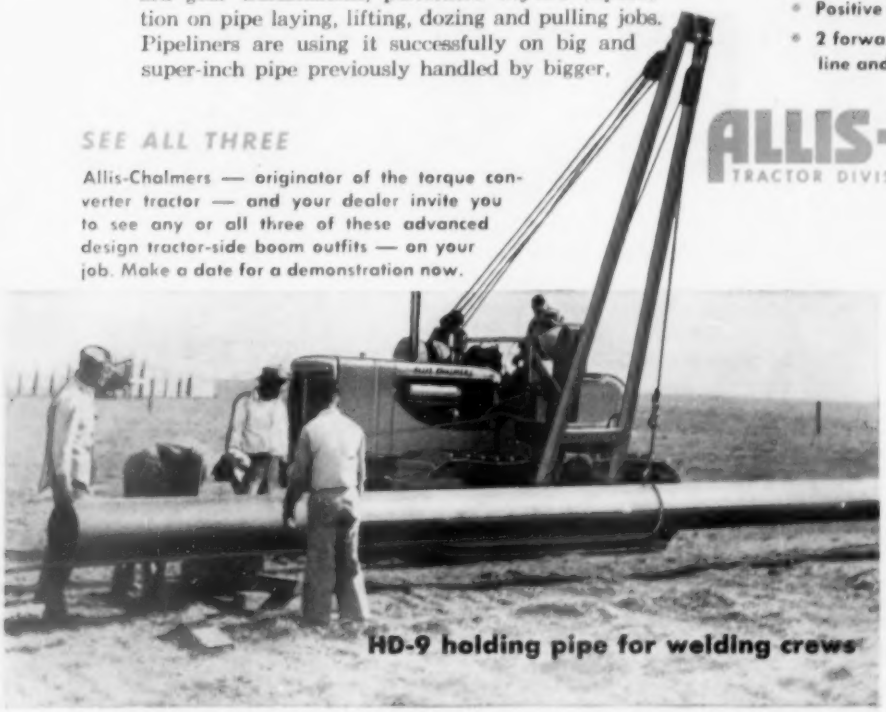
Check these side boom features

- Easy operating, convenient controls
- Completely enclosed internal expanding brakes
- Hydraulically controlled extendable counterweights
- Drop-proof counterweight linkage
- Quick-on, quick-off sectional frames
- Positive locking winch controls
- 2 forward and 2 reverse speeds for load line and boom line

SEE ALL THREE

Allis-Chalmers — originator of the torque converter tractor — and your dealer invite you to see any or all three of these advanced design tractor-side boom outfits — on your job. Make a date for a demonstration now.

ALLIS-CHALMERS
TRACTOR DIVISION · MILWAUKEE 1, U. S. A.



HD-9 holding pipe for welding crews

ALLIS-CHALMERS HD-9

- Boom tractor with standard counterweights — 30,354 lb
- Bare Tractor — 19,600
- 72 drawbar hp

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"You see POWELL VALVES everywhere!"

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Wherever flow requires dependable control, there's the place for Powell Valves—available through distributors in principal cities. Made ⅛" to 30" and 125 pounds to 2500 pounds W. S. P. Bronze, iron, steel and corrosion resistant alloys. On problems, write direct to The Wm. Powell Company, Cincinnati 22, Ohio.

CONTROLS FOR THE LIFE LINES OF INDUSTRY

Powell Valves

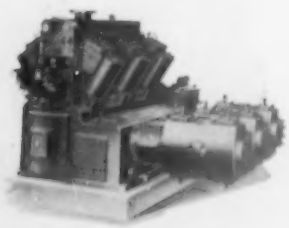
108th year

4-CYCLE GAS-ENGINE COMPRESSORS

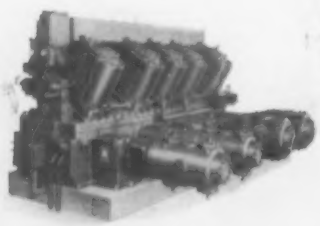
NATURALLY ASPIRATED

Six 1320-hp Ingersoll-Rand KVG gas-engine-driven compressors installed at a gas booster station in Texas serving a new 30-inch pipe line.

There's a Dependable IR *Unit for Every*



JVG 110, 165 and 220 hp
Available with 4, 6 or 8 V-angle power cylinders and 2, 3 or 4 compressor frames.

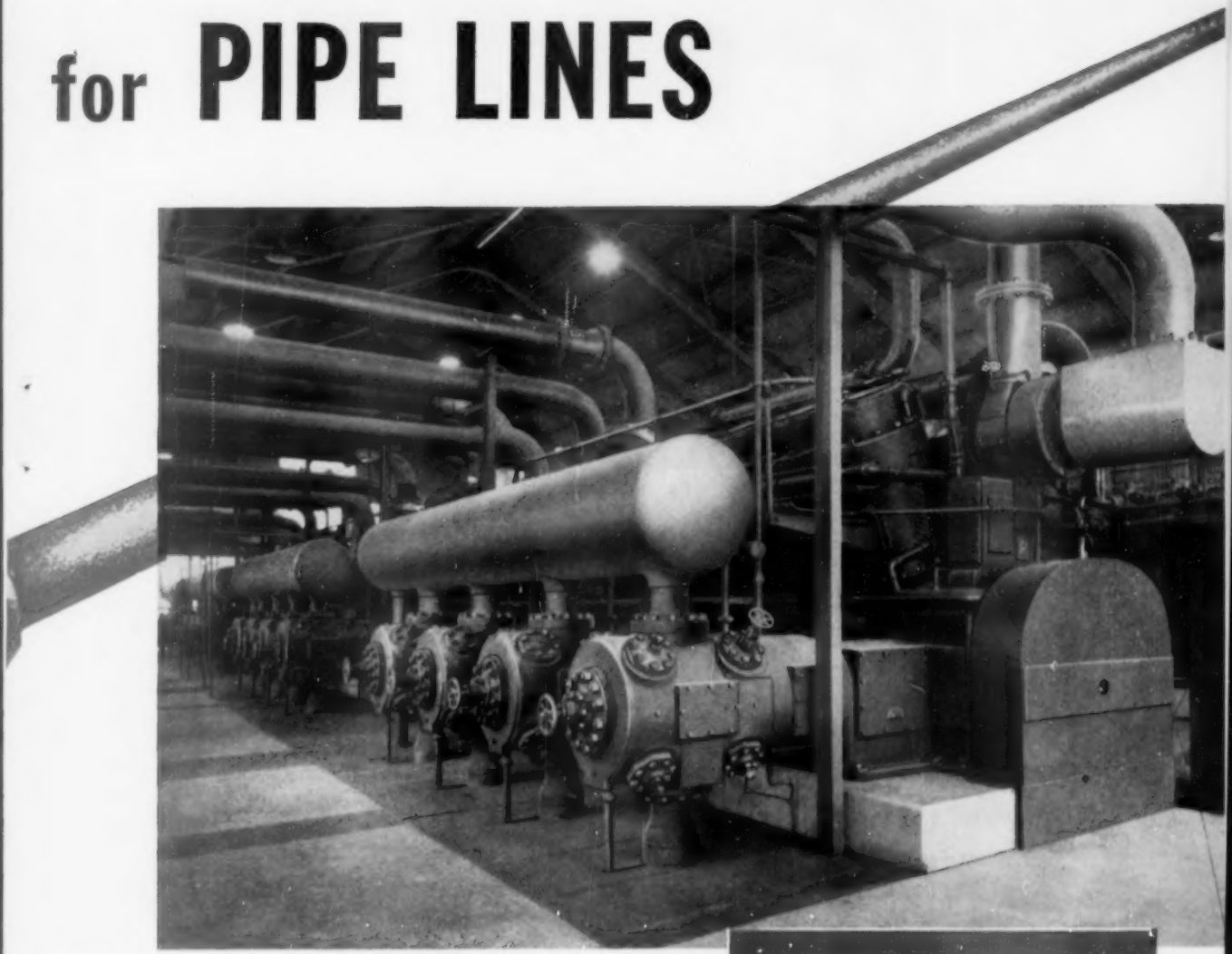


SVG 330, 440, 550 and 660 hp
Available with 6, 8, 10 or 12 V-angle power cylinders and 3 or 4 compressor frames.

KVG 660, 880, 1100 and 1320 hp
Available with 6, 8, 10 or 12 V-angle power cylinders and 2, 3 or 4 compressor frames.

Ingersoll-Rand companion 4-cycle gas engines are available to drive generators, pumps and other equipment.

for PIPE LINES



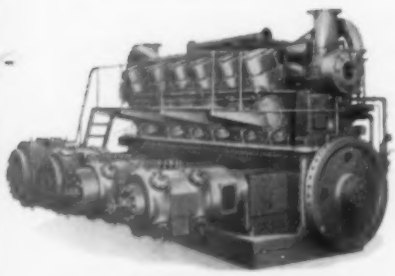
Seven Ingersoll-Rand 2000-hp KVS gas-engine-driven compressors at a natural gas pipe-line station in the Southwest—one of the first large-scale installations of the new Turbocharged unit.

TURBO-CHARGED

The KVS *Turbocharged* gas-engine-driven compressor gives Ingersoll-Rand a complete line of heavy-duty 4-cycle units from 110 to 2000-hp. In the 2000-hp KVS engine, dual exhaust-driven turbo-blowers provide intake air pressure for both scavenging and supercharging. Savings in space, weight, fuel and cooling equipment make this an important addition to the I-R line of V-angle, 4-cycle gas engines.

Whatever your pipe-line compressor requirements, Ingersoll-Rand can meet them from a *standard line*—with complete flexibility of compressor cylinder design and arrangement. With each size and type you get the traditional I-R *dependability* that means greater economies on a long-range basis. When planning *your* next installation, be sure to consult your Ingersoll-Rand representative. He can be of great help to you.

Application



KVS 2000 hp—Turbocharged
Has 12 V-angle power cylinders and four compressor frames.

6-75

Ingersoll-Rand
11 Broadway, New York 4, N. Y.

In Canada refer to
Canadian Ingersoll-Rand Company, Limited
800 Birks Bldg., Phillips Square Montreal 2, Quebec

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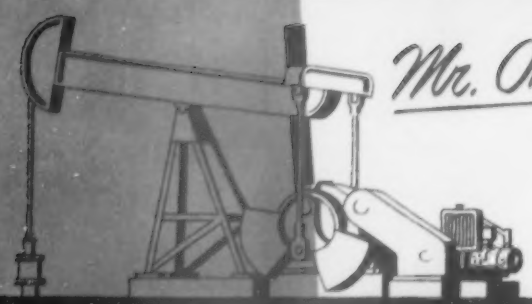

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MODEL	A.P.I. HORSE POWER RATING
5 x 6½ WL	5 to 12½ H.P.
6½ x 8 CMA	12 to 19 H.P.
7¼ x 8 CMA	13½ to 22½ H.P.
7½ x 10 CMA	16 to 26 H.P.
8½ x 10 CMA	21½ to 36½ H.P.
DP-70 11 x 14	34 to 70½ H.P.
DP-100 13¼ x 16	56 to 105 H.P.

Pick the right horsepower and *Specify*

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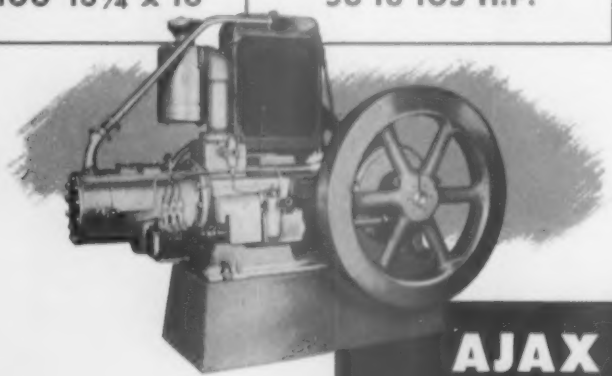
AJAX makes it easy for you to pick the type and size of pumping engine best fitted to your needs—we build them in the entire range demanded by today's oil producers. And AJAX and your Supply Man make it easy for you to compare the facts—we have them all! *Let us serve you.*



AJAX

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AJAX IRON WORKS

Builders of GAS AND OIL ENGINES, PRESSURE PUMPS, STEAM DRILLING ENGINES, INDUSTRIAL STEAM ENGINES

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Oil Field Distributors: THE NATIONAL SUPPLY CO., PITTSBURGH, PA.
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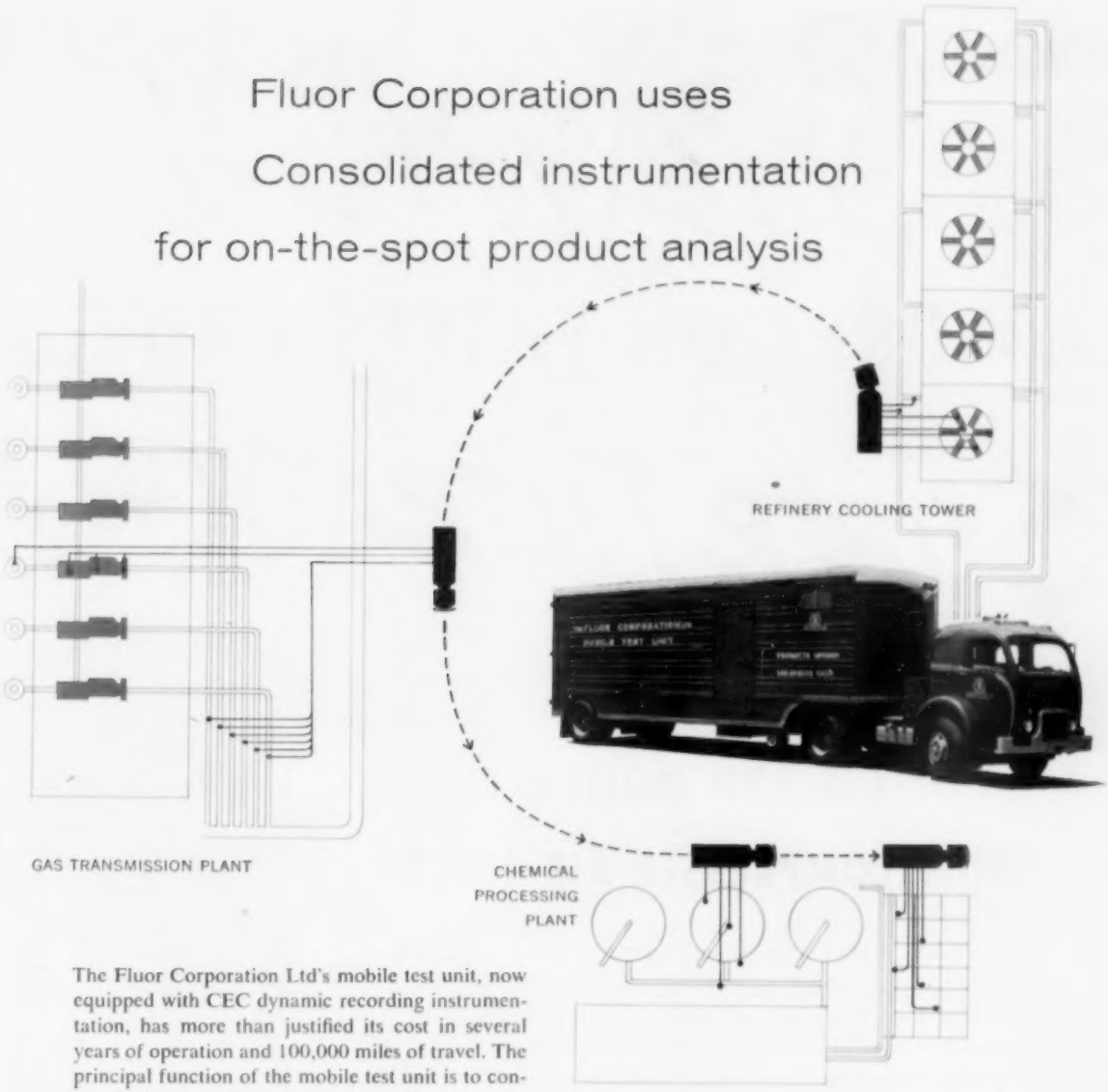
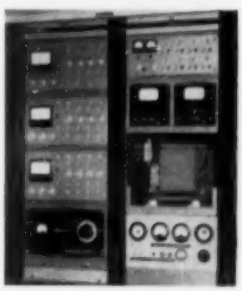
Fluor Corporation uses Consolidated instrumentation for on-the-spot product analysis



The Fluor Corporation Ltd's mobile test unit, now equipped with CEC dynamic recording instrumentation, has more than justified its cost in several years of operation and 100,000 miles of travel. The principal function of the mobile test unit is to constantly improve Fluor products such as cooling towers, pulsation dampeners and fin fan air-cooled heat exchangers by on-the-spot dynamic testing under actual operating conditions. Using a 14-channel Consolidated Recording Oscillograph, Carrier Amplifiers, Transducers and associated CEC equipment, the mobile unit can measure and permanently record every physical phenomenon encountered in the operation of Fluor's products for the petroleum and petro-chemical industries. The attractive mobile unit in its specially built van trailer serves other purposes aiding the solution of field engineering problems and conducting basic research.



Consolidated dynamic recording equipment: recording oscillograph, vibration meters, bridge balance and carrier amplifiers, are rack-and-panel mounted in Fluor's mobile research laboratory.

Free Catalog. *Write for illustrated brochure "Data Processing Instruments." Ask for Bulletin 1301-X3.*

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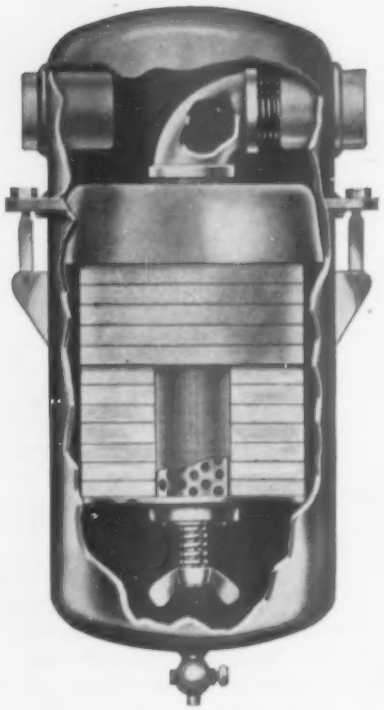
For Complete Information, Write Today For Bulletin B-1A

Representatives in Principal Cities



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Absorption Filter

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STAYNEW FILTERS

DOLLINGER

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ALL TYPES OF FILTERS FOR EVERY INDUSTRIAL NEED

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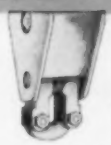
FREE **Cut-off Practice Book.** Outlines the quick, easy way to tell when to cut-off and how much. Shows how to obtain maximum service from rotary lines and avoid costly cutting too soon or too late. Carries cut-off tables for derricks of all heights operating in all major oil regions.

FREE **Handbook of Wire Rope For Well Drilling and Servicing.** More than 40 pages of useful facts on wire rope for rotary, cable tool drilling and well servicing. Includes sizes and constructions of wire rope for all oil field services, its care, lubrication, abuses, correct handling, seizing and socketing.

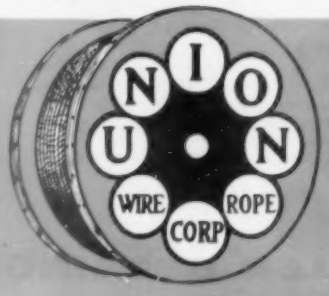


In Oil Drilling Operations Everywhere toolpushers are increasing the service for rig owners with Tuffy Rotary Line! They've found that Union Wire Rope engineers have developed a rope that can take the tough, different kind of wear that rotary drilling gives!

Tuffy is Made of high carbon steel especially patented and drawn for ultimate service. The wires are pre-shaped around an independent wire rope core—number and size of wires, lay of rope are scientifically formed into a wire rope construction that beats any ever before developed for use on rotary rigs! The result is a rope that consistently gives *extra* ton-miles of service!

Tuffy Standard Rotary Line is especially made for use with standard rigs, or for deeper drilling with jackknife rigs. It spools easily, pays off in longer service before cutting is necessary!

Tuffy Jackknife Rotary Line is an extra-flexible rope, perfect for spooling on the smaller sheaves and drums of jackknife rigs . . . yet there's no loss in strength! Get *all* the ton-miles you pay for by switching to longer-lasting Tuffy Rotary Lines!



UNION WIRE ROPE CORPORATION
2102 Manchester Avenue, Kansas City 26, Missouri

At no obligation, please rush the material I have checked below:

- ☐ Cut-off Practice for Rotary Drilling Book
- ☐ Handbook of Wire Rope for Well Drilling
- ☐ Ton-Mile Indicator and Log Book
- ☐ Put my name on the list for mailings of new Rope Dope Bulletins.

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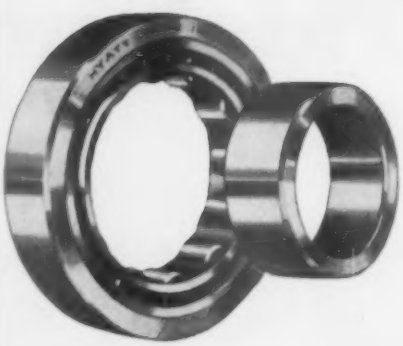
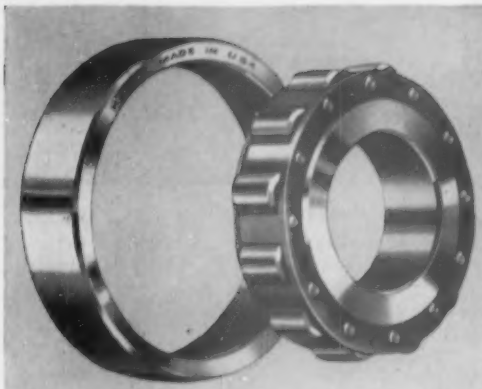
3 ways to handle your RADIAL LOAD PROBLEM

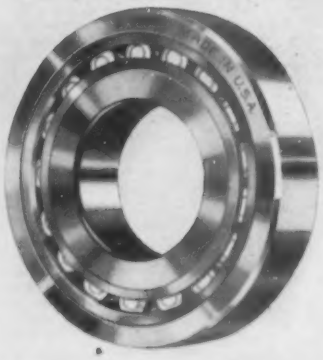


1 If your design requires a large shaft diameter to produce greater rigidity without disturbing boundary dimensions, a separable inner race type Hyatt Hy-Load bearing can be used with the inner race omitted. Rollers operate directly on a suitable hardened and ground shaft.



2 When the housing bore must be kept to a minimum, a Hyatt Hy-Load bearing with a separable outer race can be used—with the outer race omitted. The rollers then operate directly in a housing bore of suitable hardness and finish.

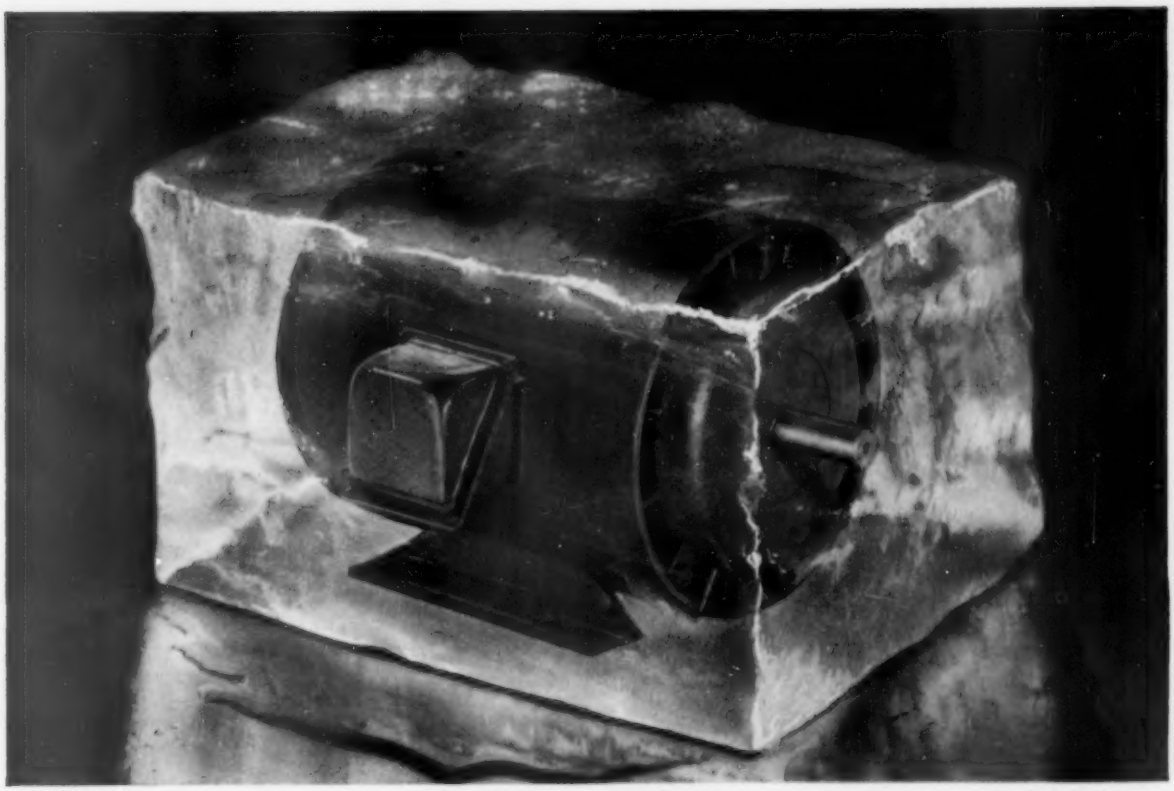
If your design applications involve radial loads, the best way to handle the job is with Hyatts—for Hyatt offers industry's most complete line of straight radial roller bearings! Hyatt Hy-Loads, for example, are made in three diameter series and two basic widths, to standard dimensions. There are ten major types—for the heaviest radial loads, and light or intermittent thrust loads. Four have separable inner races, two have separable outer races and four are non-separable, thus permitting wide flexibility in design and assembly procedures. Write for our general catalog No. 150—it will put the solution to any roller bearing problem at your fingertips. Hyatt Bearings Division, General Motors Corporation, Harrison, New Jersey.



3 For designs requiring a bearing installed as a unit, there is the non-separable type of Hyatt Hy-Load. Whether you select a separable or non-separable type of Hyatt Hy-Load, they are available in a wide range of sizes.

HYATT ROLLER BEARINGS

STRAIGHT BARREL TAPER



Let this unique illustration convey to you the remarkable cooling effect of Howell's new internal ventilation system in Series 100 Motors.

New Howell re-rated motors run cooler... last longer

Your motor needs have changed just as your machines have changed. Here are *completely new* motors . . . designed and built to meet *today's* requirements!

Now! Howell brings you everything you want in a re-rated motor: smaller size and lighter weight . . . plus *better cooling* for less maintenance and longer life.

Howell Series 100 re-rated motors feature a new internal ventilation system that provides 50% more contact between cooling air and active lamination materials. Temperature ratings are easily maintained; overload capacity is increased.

Many New Features

Series 100 Motors offer many other advantages: *They take up less space* – up to 30% less in some sizes; both open and totally enclosed fan-cooled motors have same diameters. *They perform better* – Howell uses dependable copper rotors for higher conductivity, greater flexibility; new Mylar* slot insulation is thinner (more space for copper windings), yet eight times stronger. *They last longer* – better cooling, double-shielded bearings and super tough steel frames and feet, with cast iron endplates, insure extra years of trouble-free performance. *They fit your special needs* – Howell provides rotors in three diameters for each frame size; corrosion-resistant materials and fittings are available to meet your specific industry problems.

Before you buy any re-rated motor, compare Howell Series 100 Motors for modern design, outstanding performance, and engineered precision. Howell will continue to make a complete line of regular and special motors – we have in our files more than 20,000 electrical design specifications! Let us serve you. Call your Howell man today.

*DuPont trade mark

HOWELL MOTORS

Howell Electric Motors Company, Howell, Michigan

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Starts Saving For

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at Watson, California

Another big stride in waste heat reclamation was made at Richfield's Watson refinery when their new B&W CO (Carbon Monoxide) Boiler recently went on stream.

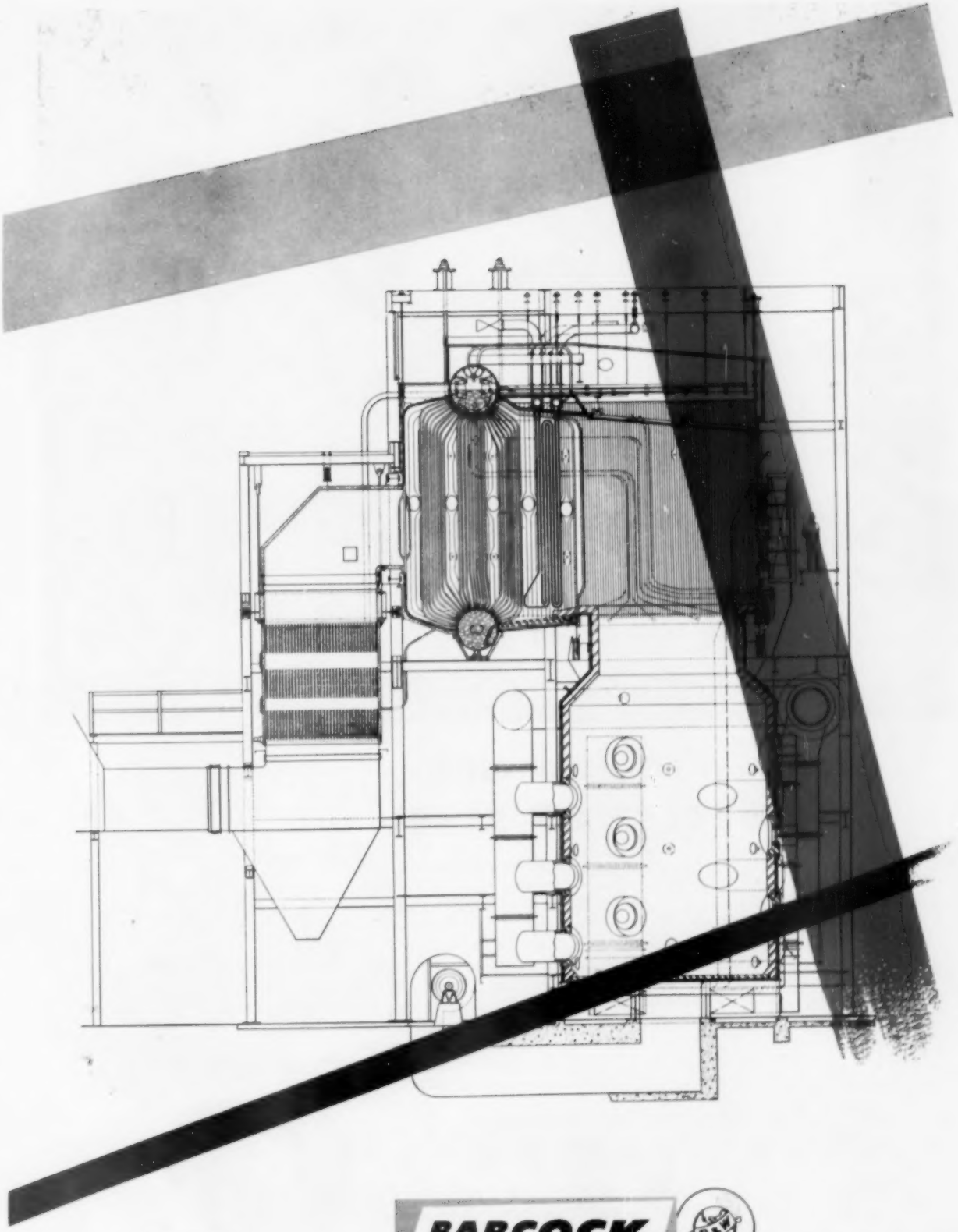
Utilizing the combustible carbon monoxide, as well as sensible heat, from the catalyst regenerator, the CO Boiler puts to work what previously was expelled to the atmosphere as waste. From now on this once costly disposal will be harnessed and burned — an efficiency that is best reckoned in dollars.

In addition, the boiler is an independent source of steam power for the entire fluid unit and its auxiliaries — operating even when the cracking unit is shut down.

Its maximum continuous capacity is 340,000 lb. of steam per hr at a pressure of 700 psi and a temperature of 750 F., burning either oil or fuel gas as primary fuels.

Besides representing a significant economic advance, the CO Boiler is an outstanding example of complete cooperation among companies with the common goal of lowering operating costs and raising an already extraordinary efficiency still higher. C. F. Braun Company, the contractors, Richfield Oil Corp, and B&W — all are major contributors to what is rapidly proving to be a *saving* advance in the petroleum industry. Let us discuss with you and with your consulting engineers the working advantages of the B&W CO Boiler and give you additional details. The Babcock & Wilcox Company, Boiler Division, 161 East 42nd Street, New York 17, N. Y.

G-668



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every industry benefits from wire rope

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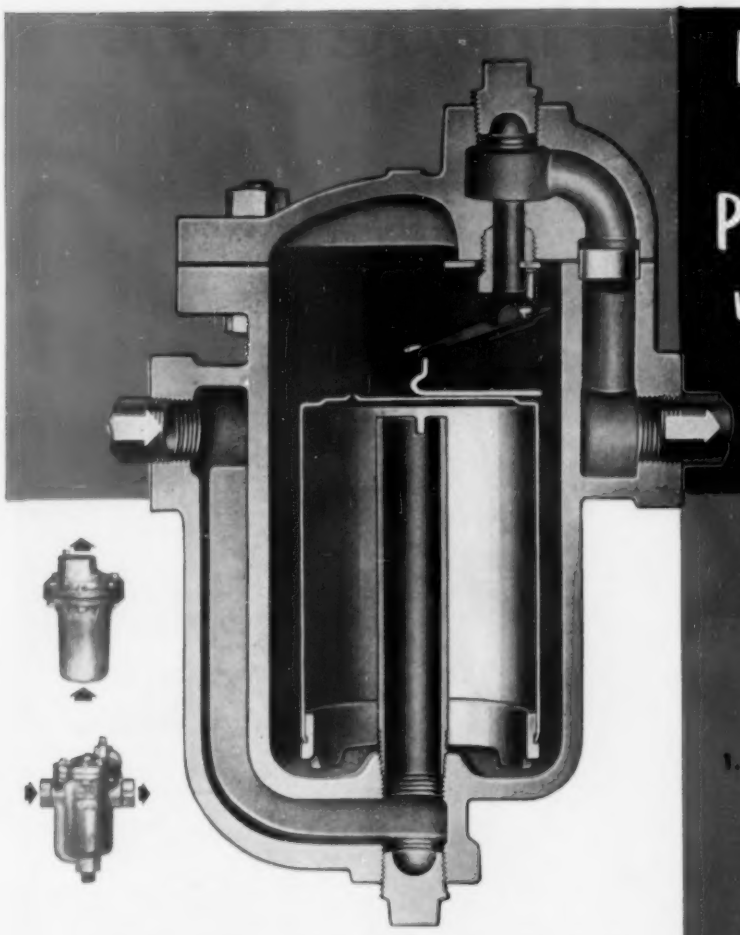


MORE TRAP CAPACITY PER DOLLAR with Armstrong two-phase leverage

Two-phase steam trap leverage is an original development by Armstrong and has been incorporated in Armstrong traps since the memory of most engineers runneth not to the contrary. It provides:

1. High initial leverage to open the valve against pressure.
2. Secondary lower leverage which permits the valve to travel well clear of the seat to minimize restriction to flow of condensate.

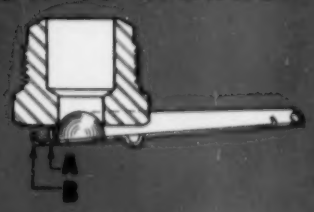
A single-phase lever can open just as large a valve *or* give just as great valve travel, *but not both.* Thus, Armstrong two-phase leverage gives very much greater capacity, depending on trap size than the earlier leverage system.

No steam trap gives greater actual hot condensate capacity, size for size, and dollar for dollar, than an Armstrong!

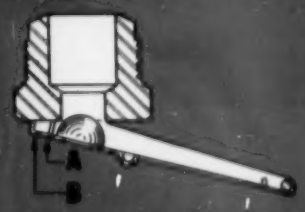
For complete data call your local Armstrong Representative or send for the 44-page Steam Trap Book.

ARMSTRONG MACHINE WORKS
868 Maple Street, Three Rivers, Michigan

HOW IT WORKS:



1. Valve in closed position.



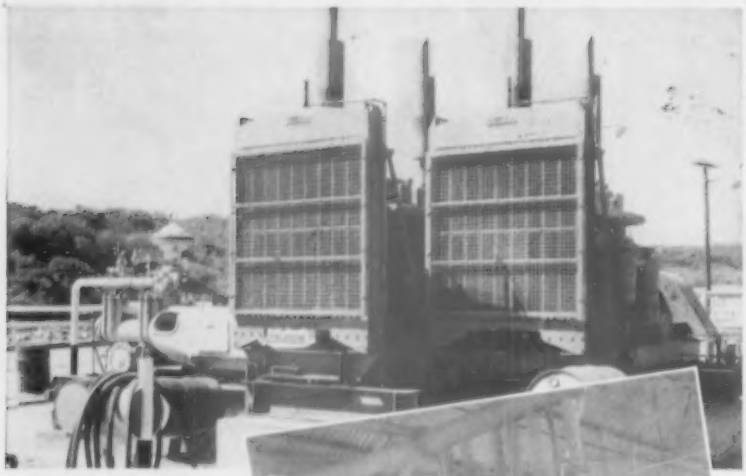
2. As the bucket starts to sink, the lever fulcrums at "A", giving high leverage to open the valve against pressure. When valve is well open, the secondary fulcrum "B" touches the face of the valve seat.

3. Additional bucket travel results in fulcrum "B" becoming the pivot, permitting the valve to be opened wider so that restriction to flow of condensate is minimized.

ARMSTRONG STEAM TRAPS

the Profitable Pipeline Power

WAUKESHA

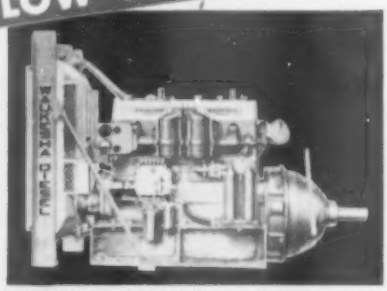


ENGINES and POWER UNITS 10 hp. to 600 hp.

HIGH OUTPUT

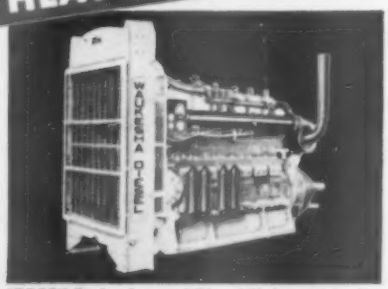
WAKBU Gas Power Unit—six cylinders, 6¼-in. bore x 6½-in. stroke, 1197 cu. in. displacement, 250 hp at 1800 rpm on natural gas.

LOW UPKEEP



NKDBU Normal Diesel Power Unit—six cylinders, 7-in. bore x 8¼-in. stroke, 1905 cu. in. displacement, 274 hp at 1200 rpm, maximum.

HEAVY DUTY



LRDBSU Turbocharged Diesel Unit—six cylinders, 8½-in. bore x 8½-in. stroke, 2894 cu. in. displacement, 526 hp at 1200 rpm, maximum.

Send for

BULLETIN 1079

It gives complete line of Waukesha Oil Field Engines for gas, gasoline, normal Diesel, or turbocharged Diesel operation—to 600 hp.

•

WAUKESHA MOTOR COMPANY

WAUKESHA, WISCONSIN

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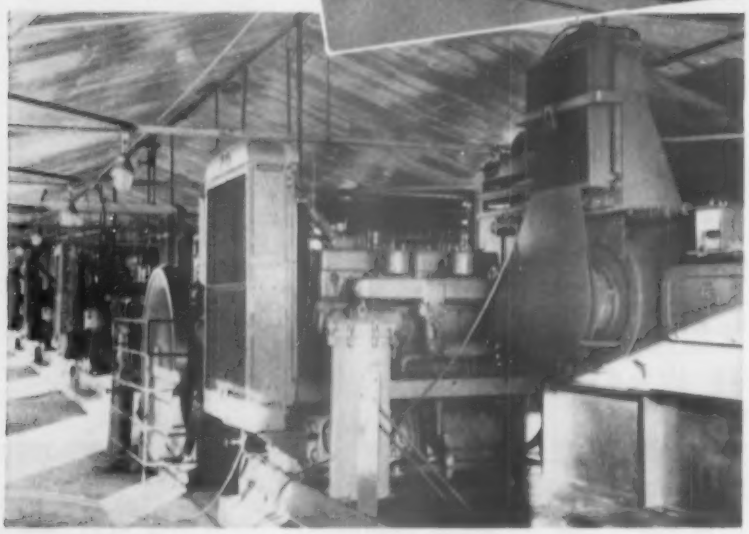

Main Compressor Headers

Natural Gas Storage Company of Illinois Compressor Station, Herscher, Ill.

PRITCHARD PUTS THE PIECES TOGETHER

Unitized Main Compressors

Gas Scrubbers

Jacket Water Controls

J. F. Pritchard & Co. has the years of specialized experience required to integrate the complex units of a modern compressor station into an efficient installation.

That's why leading companies in the gas industry, like the Natural Gas Storage Company of Illinois, depend on Pritchard. Pritchard's outstanding design skills, diversified engineering experience and proved construction ability produce facilities that assure efficient operation. Be sure to get what you want; contact Pritchard for a modern installation that fits your needs.

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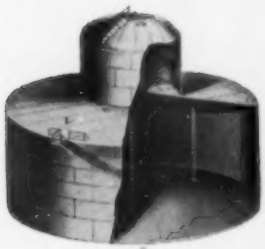
A positive activating system puts Ansul's "Plus-Fifty" dry chemical to work immediately. To insure full fire coverage, patented nozzles deliver the right kind of stream for your fire protection problem (low velocity or long range). Ansul extinguishers are water-tight, corrosion resistant, always ready for action, even after extreme weathering. Quality features like these make it possible for Ansul to back their equipment with a 5-year warranty.

Call the Ansul Man!

Get in touch with your local Ansul man through the "yellow pages" or write ANSUL CHEMICAL COMPANY, Fire Equipment Division, Department F-94, Marinette, Wisconsin.

ANSUL

the HAMMOND DIALIFT*



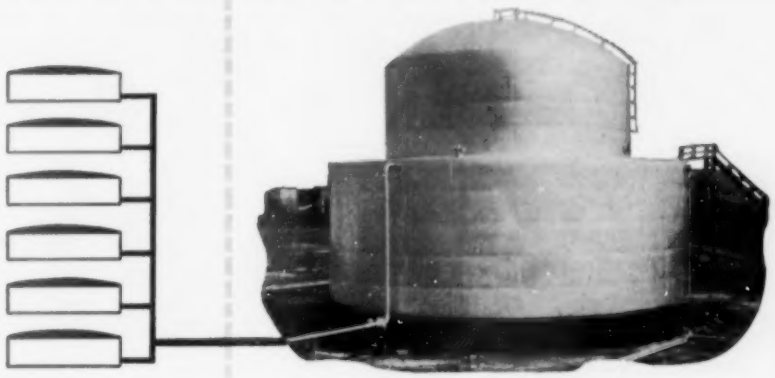
MONEY SAVER FOR PRODUCT-STORAGE OPERATORS!

The Hammond DIALIFT is the modern tank for eliminating breathing losses and reducing filling losses. It gives maximum conservation of vapors at lowest cost.

42'6" x 40' Liquid Storage Tank
22' x 17'9" Dialift. Housing — 6500 cu. ft. capacity Inter connected to a 25' x 40' Cone Roof Tank

50' x 48' Liquid Storage Tank
30' x 15'9" Dialift. Housing — 12,500 cu. ft. capacity

The DIALIFT consists of a tubular membrane attached gas-tight to the inside periphery of a cylindrical housing. In operation the DIALIFT functions as the lung of the storage tank. The membrane lifts under a slight pressure when additional vapor storage space is needed, and lowers when less vapor space is required; self-adjusting to the constantly changing breathing conditions within the tank.



80' x 30' Liquid Storage Tank
35' x 17'9" Dialift. Housing — 20,000 cu. ft. capacity

It is easy to convert an existing Cone Roof Tank to an efficient DIALIFT installation. A DIALIFT housing is superimposed on the existing roof, breather holes are installed through the roof plating permitting a free passage for all vapors, no other preparation is necessary.

60' x 48' Ground Type Dialift. 150,000 cu. ft. capacity

*patented

Bulletin 5301 details and describes the Hammond Dialift . . . *Write for your copy.*

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NEW! Self-Adjusting Explosion-Proof EXPANSION UNIONS by APPLETON

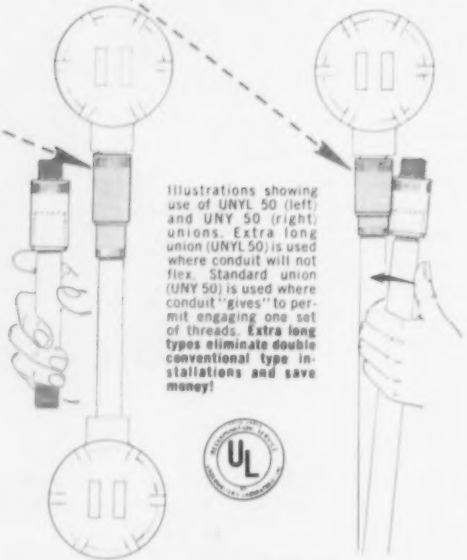
Explosion-Proof . . . Fully Extended or Intermediate Positions

Only ONE Unit . . . Two Moving Parts

APPLETON Explosion-Proof Expansion Unions are completely new and different . . . afford an ease and simplicity of installation never before known with this type of explosion-proof equipment!

Expansion adjustment is built-in! The *two* moving parts telescope or expand to accommodate usual thread lengths. Only *two* tightening operations . . . each made separately! Smaller external diameters for convenient use in restricted quarters! Precision construction for absolute explosion-proof protection . . . no need to worry about failure to draw surfaces together . . . the union remains completely explosion-proof at all times, regardless of its retracted or extended position! Special design guarantees positive ground at all times!

Get acquainted with the *extra* quality and utility built into APPLETON Explosion-Proof Expansion Unions. Write for complete details.



Illustrations showing use of UNYL 50 (left) and UNY 50 (right) unions. Extra long union (UNYL 50) is used where conduit will not flex. Standard union (UNY 50) is used where conduit "gives" to permit engaging one set of threads. **Extra long types eliminate double conventional type installations and save money!**

EXTRA LONG
UNYL Union showing up to 1-11/32" expansion . . . serves the purpose of two conventional type unions!

STANDARD
UNY Union showing up to 21/32" expansion . . . for installation wherever conventional types were previously used!

Sold Exclusively Through Selected Wholesalers

APPLETON ELECTRIC COMPANY
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Also Manufacturers of:

Rely on **APPLETON** *. . . The Standard for Better Wiring*

WHEN YOU WANT CHAIN
THAT WORKS LIKE A

SPECIFY
REX ROLLER CHAIN*

BUSY CHAINS... CHAINS THAT WORK
AROUND THE CLOCK WITHOUT LYING DOWN
ON THE JOB... THAT'S REX ROLLER CHAIN

CHAIN BELT COMPANY
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*WE'VE CHANGED OUR NAME...but the chain's the same. Baldwin-Rex Roller Chain is now called Rex Roller Chain and the Baldwin-Duckworth Division is now known as the Roller Chain Division of Chain Belt Company.

STOCKED BY LEADING SUPPLY STORES

You can get Jones Sucker Rods from leading supply stores in or nearby most fields. Through these local supply centers you have direct access to Jones representatives and engineers—well qualified to serve you and cooperate in the solution of production problems.

LOOK FOR THE GREEN RODS

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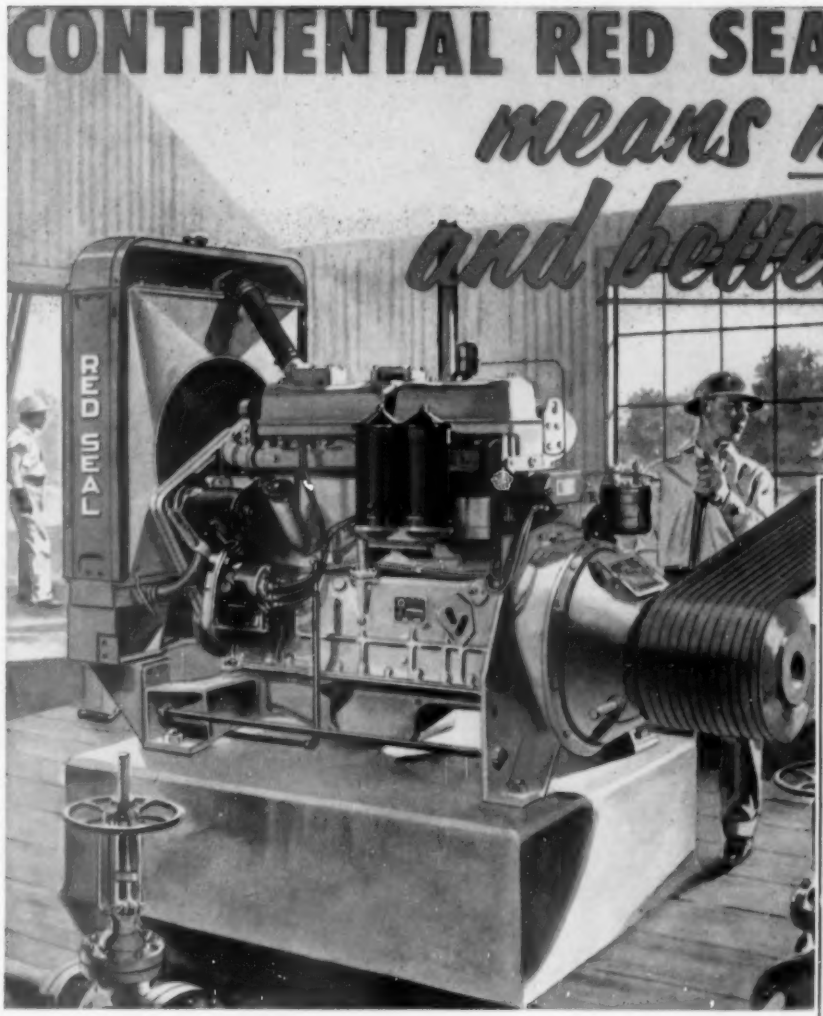
CONTINENTAL RED SEAL® *means more and better power*



NO OTHER ENGINE GIVES YOU ALL THESE ADVANCED ENGINEERING FEATURES

PATENTED INDIVIDUAL PORTING

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FULL-LENGTH WATER JACKETS

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TOCCO-HARDENED COUNTER-BALANCED CRANKSHAFT

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LEAKPROOF WATER PUMP

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ALLOY STEEL VALVE SEAT INSERTS

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PATENTED OIL AND DUST SEALS

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POSITIVE ROTATION EXHAUST VALVES

This patented and exclusive Continental system of Individual Porting is only one of many features which join to assure top performance in Continental Red Seal engines and power units. Arrows indicate how its scientifically located and designed galleries deliver uniform fuel charge to all cylinders.

Continental Red Seal engines for oil field use cover a wider power range today than ever before. If your requirement falls between 2 hp and 1,000, and if *dependability* is just as important as power, there's a Red Seal model built to meet it—and that Red Seal is your one best bet. Ask your oil field supply store, or write the nearest Continental office.

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Continental Motors Corporation

MUSKEGON, MICHIGAN

CONTINENTAL MOTORS ® Powerful as the Nation AMERICA'S STANDARD

Maltese Cross Fire Hose for severest service . . . extra strong yet light and flexible. Standard lengths: 50 feet—tested up to 400 psi.

MALTESE CROSS® FIRE HOSE

IS THE FINEST IN FIRE PROTECTION

Maltese Cross Fire Hose has *never* failed at a fire, has always given peak performance when needed as shown in these three case histories.

(1) . . . A large New Jersey refinery battled a stubborn fire with five brands of fire hose. All brands burst on the job except Maltese Cross Fire Hose, and that same hose has been in use now for over 30 years!

(2) . . . Not one length of 20-year-old Maltese Cross Fire Hose failed in one of the century's worst refinery fires. Thirty-nine lengths of other brands of fire hose burst during action.

(3) . . . A large refinery refused to buy higher priced Maltese Cross Fire Hose but settled for a lower cost hose. When a fire occurred their cheaper hose lengths burst one after another. They borrowed hose from a nearby refinery . . . Maltese Cross Fire Hose. Not one length burst. Today Maltese Cross Fire Hose is a standard part of their fire-fighting equipment.

Here is proof that Hewitt-Robins Maltese Cross Fire Hose offers the greatest safety and economy over the years . . . it will never mildew or dry-rot during storage . . . it is oil, acid and abrasion-resistant and built to withstand the severest pressures . . . it's the *handmade* fire hose whose wrapped construction includes four tough flexible plies of specially woven duck combined with premium rubber compounds. Maltese Cross Fire Hose is widely used and approved for oil tanker service because it resists weathering and salt spray.

Your investment in Hewitt-Robins Maltese Cross Fire Hose will insure *complete* and *proven* protection in your industrial fire protection system.

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Executive Offices, Stamford, Connecticut

DOMESTIC DIVISIONS: Hewitt Rubber • Robins Conveyors • Robins Engineers • Restfoam

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The chips that talk...

To the native savage, whose tribe had no conception of a written language, the piece of wood on which the explorer scribbled a message became the wonderful "chip that talks."

The chips of metal that pour in silver drifts from the mighty machines in Sun Ship's Wetherill plant tell their stories, too. Those shown on the 14-foot boring mill tell part of the story of a fast, thorough repair job on ship-propulsion machinery. That job required lifting a 54-ton section of crankshaft from the ship to a 10 ft. x 50 ft. engine lathe, where it was checked for trueness and the journals machined. The crankpins were machined in a huge crankshaft machine. The boring mill operation shown was the facing of the webs of a new section which replaced one of the damaged sections of the crankshaft.

That's the kind of story the versatile men and machines at Sun Ship have been writing for decades . . . in building special machinery of every type for the varied industries that are building a greater America.

Sun

SHIPBUILDING & DRY DOCK COMPANY

ON THE DELAWARE SINCE 1916 CHESTER, PA.

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wherever pipe lines hit rock . . .

use the GARDNER-DENVER Twindril®

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THE QUALITY LEADER IN COMPRESSORS, PUMPS AND ROCK DRILLS FOR CONSTRUCTION, MINING, PETROLEUM AND GENERAL INDUSTRY

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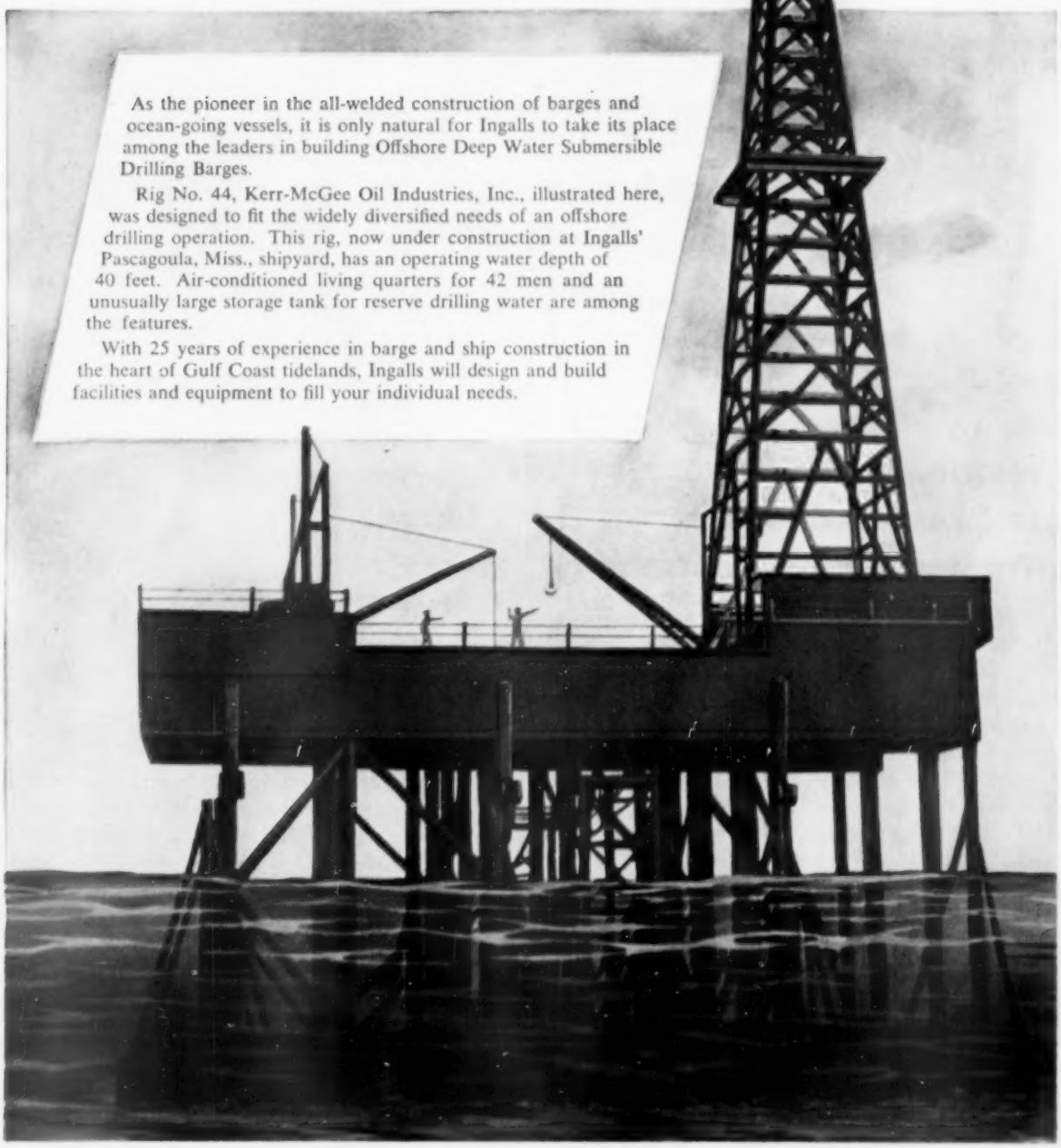
Oil Drills Get Sea Legs

As the pioneer in the all-welded construction of barges and ocean-going vessels, it is only natural for Ingalls to take its place among the leaders in building Offshore Deep Water Submersible Drilling Barges.

Rig No. 44, Kerr-McGee Oil Industries, Inc., illustrated here, was designed to fit the widely diversified needs of an offshore drilling operation. This rig, now under construction at Ingalls' Pascagoula, Miss., shipyard, has an operating water depth of 40 feet. Air-conditioned living quarters for 42 men and an unusually large storage tank for reserve drilling water are among the features.

With 25 years of experience in barge and ship construction in the heart of Gulf Coast tidelands, Ingalls will design and build facilities and equipment to fill your individual needs.



Artist's Conception of Rig No. 44

BUILDERS OF:

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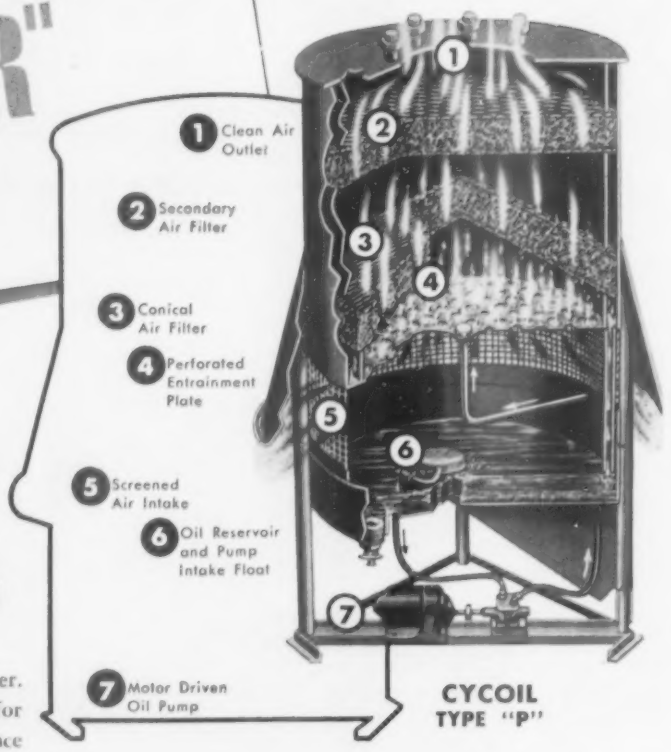
Rx Just what the "DOCTOR" ordered!

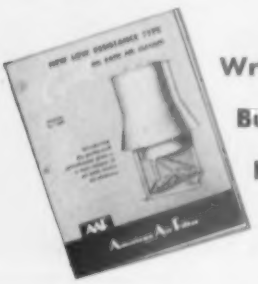


NEW LOW RESISTANCE CYCOIL OIL BATH AIR CLEANER KEEPS PACE WITH MODERN ENGINE DESIGN

The "doctor" in this instance was the engine designer. Wider use of turbo-chargers and pressure blowers for scavenging dictated the need for a new low resistance oil bath cleaner.

The Type "P" Cycoil utilizes a new principle in oil bath air filters—a perforated entrainment plate. The plate, over which oil flows from a central distributing head, is placed in the air stream. Its metered orifices are calibrated to increase the velocity of air flow through the openings to entrain the oil that tends to spill over the edges and distribute air flow uniformly over the area. With entrainment accomplished, the air then passes upward through primary and secondary filters for removal of its dust and oil content.

The new low resistance Cycoil is available in two types —(1) Type "P" with standard metered orifices for engines operating from 50% of rated capacity to maximum rating and (2) Type "PV", which by adding Vari-flow valves to orifice openings, assures sustained high cleaning efficiency from as low as 10% of rating to full capacity. For complete product information, call your local AAF representative or write direct for Bulletin No. 160.



Write For Bulletin No. 160

American Air Filter

COMPANY, INC.
444 Central Avenue, Louisville 8, Kentucky
American Air Filter of Canada, Ltd., Montreal, P. Q.

Move More with a MICHIGAN

"Fast, easy to operate, simple to adjust — ideal machine for owner and operator"—R. E. GOODSON, owner

JOB . . . . . **Drainage ditch about ½ mile long—12′ top, 10′ bottom, 8′ deep, Olanta, S. C.**

MACHINE . . . . **C-16, dragline**

OWNER . . . . . **R. E. Goodson, Darlington, S. C.**

YARDAGE . . . . **450 per day**

MATERIAL . . . . **Gumbo clay**

FUEL . . . . . **15 gallons, 10 hours**

COMMENT . . . **"Best machine ever operated. Air control outstanding feature . . . extremely fast, few adjustments, operator fatigue absolute minimum. Perfect flotation with 30" pads—on hills, in swamp. Easy to inspect all working parts"—Dave Blackmon, operator.**

Here's why 3 of every 5 MICHIGANS sold are repeat orders!

- *AIR CONTROL—FAST, SMOOTH, EASY.* Production goes up, fatigue goes down, with a MICHIGAN. Swing is fast, smooth, jerkless—easier on the machine, easier on the operator. It's the air-power pioneer—the MICHIGAN Line.

- *ONE-PIECE CIRCLE GEAR AND CARBODY.* A long, useful and economical life is built into MICHIGANS by the circle gear and carbody cast in one piece. Hook roller paths taper to match the rollers.

- *CAST TURNTABLE FOR UNINTERRUPTED SERVICE.* Here's construction usually found in biggest machines: turntable deck, side frames and hook roller mounting brackets cast integral. Eliminates common cause of wear and replacement.

- *MS CLUTCH . . . QUICKLY REPLACEABLE.* An exclusive MICHIGAN feature—this single-disc double-faced clutch with six interchangeable segments on each face. Replace a clutch in the field in a matter of minutes. Always efficient, and an amazing time-saver.

- *EASY MAINTENANCE AND SERVICE.* Grease the job in minutes per day, compared to 1 or 2 hours usually required. Antifriction bearings reduce maintenance. Air control does away with complicated linkages—toggles, joints, bushings—thus eliminating tedious greasing.

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Construction Machinery Div.
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MICHIGAN Power Shovel Fact Folio

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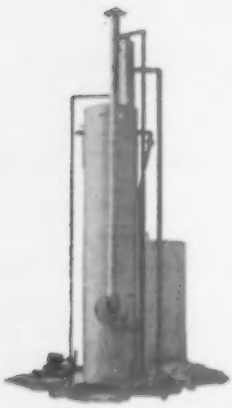
Dunham Tanks



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A fresh, new competitive picture for the tank market brings better service and quality!

MODERN

Our Minden, Louisiana, plant has been equipped with the latest and most modern mechanical equipment available. This means faster and more efficient production!

EXPERIENCE

Dunham Tanks are designed and supervised by experienced engineers who have years of tank manufacturing knowledge and know-how. This experience has already corrected many faults prevalent in equipment in the field. It is your guarantee for a better job!

SERVICE

Try us today for prompt, courteous, competent and reliable service! Sales offices are at Lafayette and Shreveport, La.; Kilgore and Corpus Christi, Texas; and, Seminole and Perry, Oklahoma. We will open more offices as soon as competent men can be hired and trained.

Our Minden, Louisiana, plant

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. . . television, radio, or microwave relay . . .

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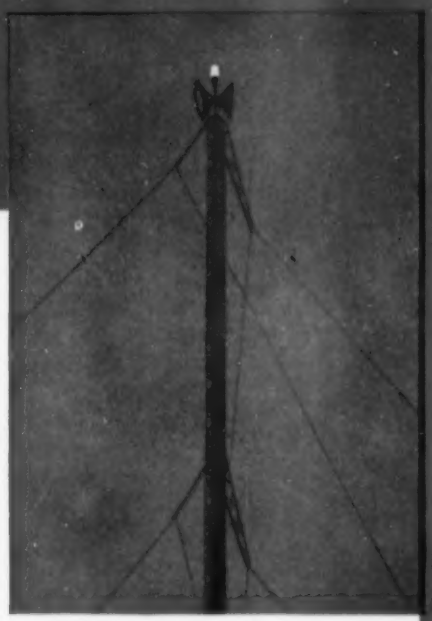
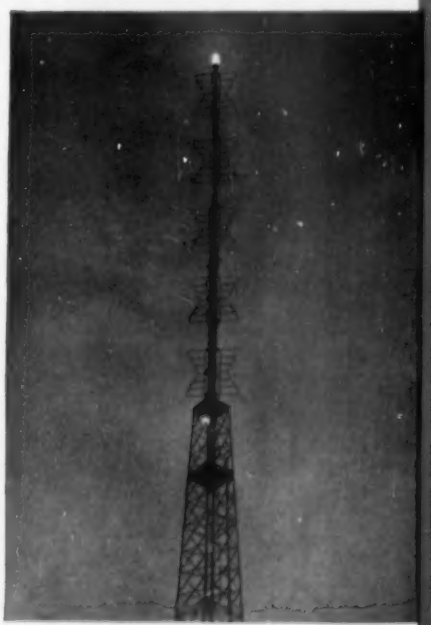
Crouse-Hinds Technical Data Bulletin 381-F contains important information on television, radio, and microwave relay tower lighting and tells you exactly what you need to do the job. There are layout drawings with complete bills of material for lighting towers of all heights. All of the information meets the requirements of FCC and CAA specifications.

A complete line of alarm relay equipment is available for remote indication of lamp failure as required by the FCC for unattended stations.

Send for your copy of this helpful bulletin today.



A Microwave Relay Tower with Crouse-Hinds Obstruction Lighting Equipment



A Television Tower with Crouse-Hinds Obstruction Lighting Equipment

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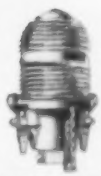

Type EOL Single Obstruction Light

Type FCB-12 Fresnel Beacon

Type TSS Flashing Switch

A Nationwide Distribution Through Electrical Distributors

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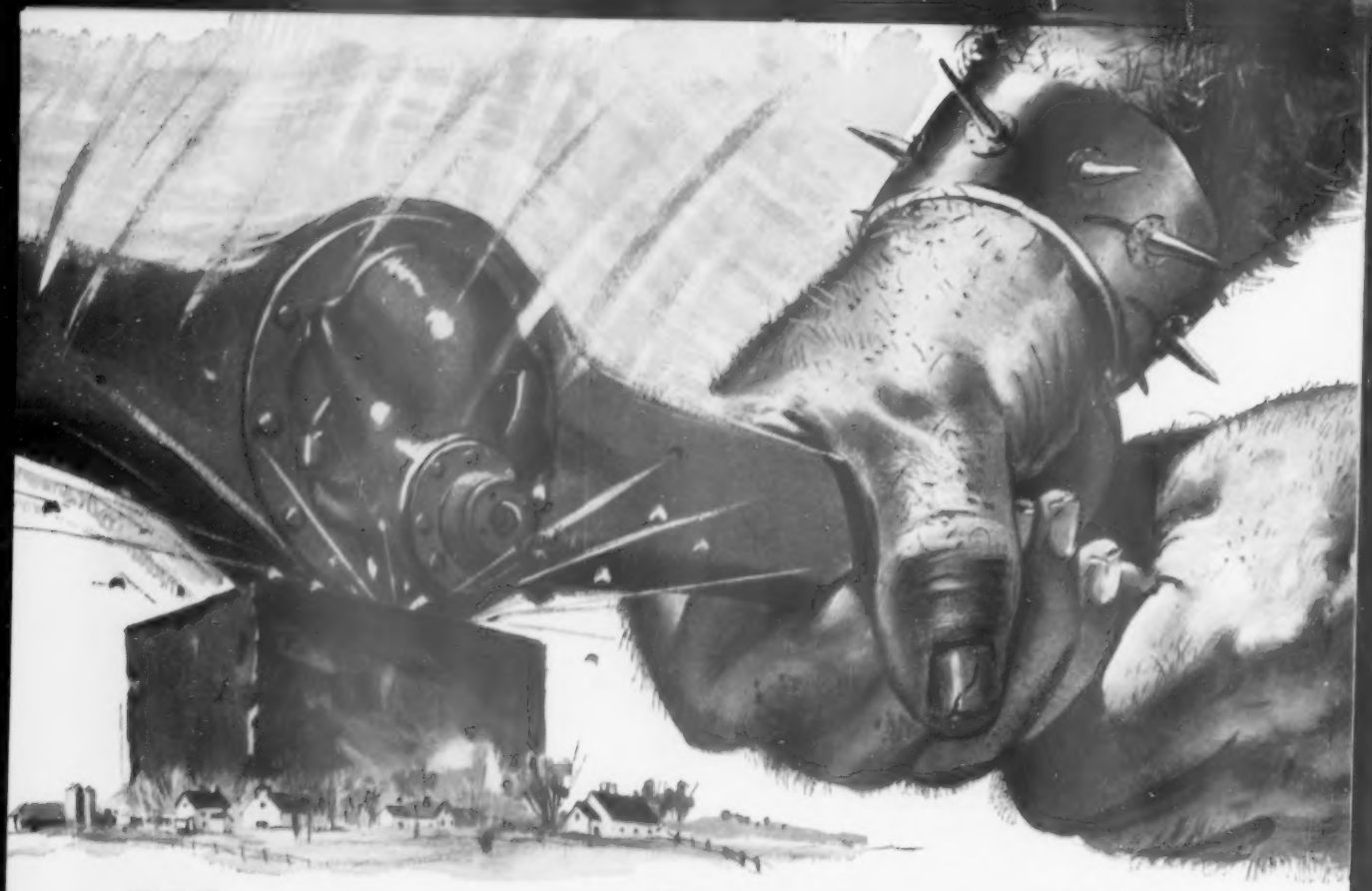


We give truck axles a brutal

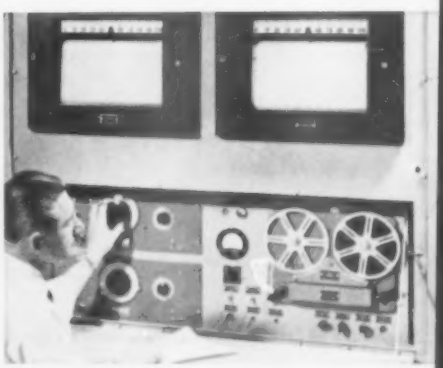
in the new Timken-Detroit indoor proving ground ...and only Timken has it!

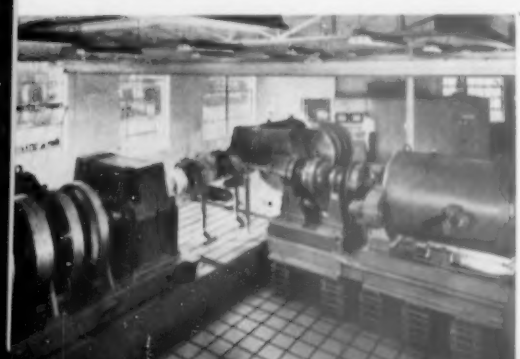
We smash, twist, jerk and over-load them. Match every imaginable hauling situation. Then add a few ruinous tricks of our own.

It's done on purpose. So we can tell you in advance that a Timken-Detroit axle can take a more brutal beating on the job it was designed for than any other axle made.

To prove it, we condensed a multi-thousand acre proving ground into one room. In it, our engineers can apply 50 years of experience in building axles for trucks, buses and trailers. Here axles and gearing are subjected *indoors* to any possible *outdoor* hauling condition. Axle performance is measured and analyzed under absolute scientific control!

As a result: you enjoy longer axle life; less maintenance, repairs and down-time; lower operating costs; fatter profits. No wonder Timken-Detroit axles are the choice of manufacturers and owners everywhere!





How TDA proves axle quality in this "Torture Chamber."

We take one of our axles and put it on the "block". . . . then duplicate the roughest hauling condition, hour after hour, day after day . . . such as simulating 500,000 miles of toughest driving in just a few days. Or we "dream up" a test like going up hill with a full load at 45 m.p.h. from California to New York—*non-stop*. There is no other axle testing like it in the world!

This is our "truck driver." He works in the "Torture Chamber." Above him are graphs showing speed and torque performance under any operating condition he chooses . . . soft ground at full load . . . mountains . . . express highways or side roads. With special dials, recorders and electronic devices, he actually *drives* the axle with scientific accuracy from his chair!

You haul heavy machinery. And you're sure with Timken-Detroit axle shafts. Proved capable of being twisted 14°—forward and backward—36 times a minute, 24 hours a day, for days on end. Only Timken-Detroit "Torture-Tested" axles can take this brutal treatment—assure you top performance—make you more money per load.

beating

TIMKEN Detroit AXLES

TIMKEN-DETROIT AXLE DIVISION
ROCKWELL SPRING AND AXLE COMPANY
DETROIT 32, MICHIGAN

The Accepted TDA Standard

TRADE MARK REGISTERED

"TORTURE-TESTED"
to Save Money on the Job

WORLD'S LARGEST MANUFACTURERS OF AXLES FOR TRUCKS, BUSES AND TRAILERS

Timken-Detroit "Letter Series" Front Axles

Here is easy, positive steering control. A little man can handle a large rig with TDA front axles as easily as a big 210-pound, six-footer, at fast or slow speeds . . . on smooth or rough roads. No wheel kickback. Tractor hook-ups have smallest possible turning radius—greatest maneuverability.

Timken-Detroit "Letter Series" Rear Driving Axles

Hypoid gearing for truck axles was pioneered by Timken-Detroit. And only Timken-Detroit has Hypoid gearing in a complete "family" of 7 basic axle capacities—in the entire range of medium and heavy-duty requirements. This advanced-related design incorporates the same features of construction and interchangeability in a choice of 3 types of Hypoid final drives using the same axle shafts and housing—single-speed; single-speed double-reduction; and two-speed double-reduction units.

Timken-Detroit Tubular Trailer Axles

Famous for their light weight. Produced in the largest, most modern axle plant in the world. Lightweight Fabricated Brake Shoes with Econoliners for greater wear, longer service. Alloy steel spindles electrically welded to tubular housing—with welding guaranteed for the life of the axle. Lightweight Nylon Bushings in Brake Camshaft Assemblies.

Increase axle life with Genuine TDA Equipment Parts

Take no chances with ordinary replacement parts. For sure, dependable factory-type jobs, look to genuine Timken-Detroit axle parts kits—identical to your axles' original equipment.

Each kit is *complete*—gives you everything you need—in one handy package. Gaskets and shim parts, brake liners, steering knuckles, differential gears—for every size of brake and axle. Order by number from your dealer. Cut labor and adjustment costs. Get trucks back on the road quicker!

Plants at: Detroit, Michigan • Oshkosh, Wisconsin • Utica, New York • Ashtabula, Kenton and Newark, Ohio • New Castle, Pennsylvania

the best way also happens to be the easiest way to start and stop a pig

Unibolt Scraper Trap Closures present a truly convenient and practical means for blanking off a line so that pigs may be easily inserted and removed from the trap. Release two bolts and the blanking plug swings open on a sturdy hinge. The scraper barrel being slightly larger than the pipe itself, the pig is easily inserted or removed. It is no longer necessary to "fight" the pig in and out of the trap. Swing the trap shut, tighten the bolts, and that's all. Let the pumps do the work. No heavy blind flanges to lift on or off. No multiple bolts to release and make up. Nothing to fall on the workmen. No leaky threads. An oil-resistant gasket seals automatically . . . seldom needs replacing.

UNIBOLT SCRAPER TRAP

with trouble-free, self-sealing gasket

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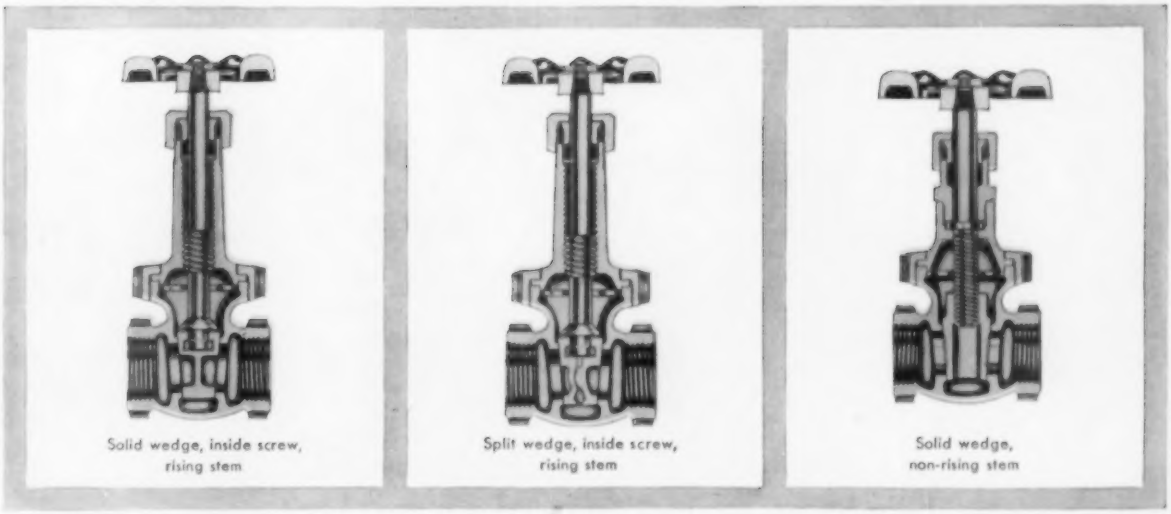
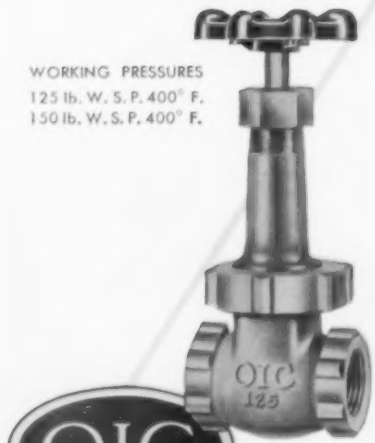
P. O. BOX 1184

CRAVER CO.
HOUSTON, TEXAS

Oh, I see



. . . we've added 125 and 150 lb. bronze gate valves to our union bonnet line



WORKING PRESSURES
125 lb. W. S. P. 400° F.
150 lb. W. S. P. 400° F.

Success of our 200 lb. line of union bonnet bronze gate valves necessitates expansion of the line to include 125 lb. and 150 lb. classes. Sizes range from ¼ to 2 inches.

NOTE THESE ENGINEERING FEATURES:

This line has a flat seat on the bonnet which mates against the body, providing adequate bearing area for sealing.

Tight bonnet joint, but easy access to interior for inspection and service.

Full ports permit unobstructed flow.

Back-seating arrangement permits repacking while under pressure.

Split wedge has ball in socket contact . . . permits wedge to adjust itself to seat.

Slip-on type "T" head stem-to-wedge connection.

Lug-type hexes make valves compact and provide a better wrench-gripping surface.

To learn more about this expanding line of valves, write for our *Union Bonnet Bronze Gate Valve Catalog Folder.*

THE OHIO INJECTOR COMPANY • WADSWORTH, OHIO

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FOUNDED 1883

VALVES | **FORGED & CAST STEEL, LUBRICATED PLUG, BRONZE & IRON**

THE BEST BALANCE OF PRESSURE AND VOLUME FOR JET DRILLING!

See a Wheland HP-14000 Pump in operation—you'll learn how drilling contractors everywhere are reducing drilling time and bit costs as much as 50%! The HP-14000 delivers the pressure and volume it takes for making hole in a hurry.

The Wheland HP-14000 is *the* pump for jet drilling . . . and the best pump for jet drilling is the best pump for *any* drilling.

Like any pump used on jet drilling, this pump must be fitted with proper size liner and run at correct speed and pressure in relation to:

1. Size, condition and depth of hole.
2. Type and size of drill pipe, drill collars and jets in bit.

DATA SHEETS from actual jet drilling performance available on request. Write for detailed bulletin

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HP-14000 7½" x 14"

DUPLEX SLUSH PUMP

350 HORSEPOWER
NOMINAL INPUT AT 60 R.P.M.

Discharge Pressure
with 7½" liners 838 PSI
Discharge Pressure
with 5½" liners 1627 PSI

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"WE'RE GETTING top performance from this type of rope. And it's the same with all the other ropes we use... Roebling makes a construction and size that's absolutely right for our requirements. When we buy Roebling we get exactly what we want, when and where we want it."

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Roebling is one manufacturer who makes a complete line of wire rope for the oil fields. And no matter where you are, there's a convenient Roebling branch or distributor to give good and fast service. Call your nearest Roebling office or distributor for a Field Man. He'll recommend the best rope for your equipment, and you'll get it on time and right. District Offices at Cleveland, Denver, Houston, Los Angeles, Odessa and Tulsa.

ROEBLING CF

Subsidiary of The Colorado Fuel and Iron Corporation

THERE'S A ROEBLING
DISTRIBUTOR
IN YOUR PHONE BOOK

Republic Aviation operates P&H high-frequency welders as standard metallic arc welders, also, so that duplicate equipment does not have to be purchased.

More than doubles welding speed with P&H

30 P&H TH-200 high-frequency machines make inert gas arc welding 2½ to 3 times faster than former gas welding at Republic Aviation Corporation

No replacement maintenance in three and a half years of two-shift operation

You don't have to take our word for the outstanding performance record of P&H Welders. The following statements are actual quotes from a certified report issued by the H. P. Gould Co. of Chicago, who made an impartial study of welding operations at Republic Aviation Corporation, Farmingdale, L. I., N. Y.

"In the building of faster and better aircraft, new developments in welding have played an important part and P&H high-frequency inert gas welding has proved that it can solve the problems of welding aluminum alloys.

"Three and a half years ago, Republic Aviation tested P&H TH-200 HF Inert Gas AC Arc Welders, and evaluated them against the existing equipment in the plant, as well as against outside competition.

"P&H welders of four different types are now used in four locations in the plant, for the welding of hundreds of different parts. In general, they are welding aluminum alloys from .032" thickness up to .250", and heat-resisting alloys from .010" up to a thickness of .093". For arc-welding alloy steels (4130, 4140, 8630, 8740, etc.), experience has proved P&H electrode AW-4 most satisfactory, and it is used exclusively.

"Republic Aviation welding engineers back up the claim of the makers that P&H welders require very little maintenance. The 30 high-frequency arc welders have had no replacement maintenance whatever in three and a half years of two-shift operation — and the operating cost of each P&H TH-200 HF Welder is only 40¢ per day."

Like Republic Aviation, whose studies show P&H inert gas arc welding to be 2½ to 3 times as fast as former gas welding you, too, can enjoy the money-saving advantages of P&H Arc Welders with Dial-lectric Control. You, too, can get faster, better welds at lower cost.

We've given you the Republic Aviation story in a nutshell! You can get all the detailed facts and figures by reading Gould Report No. 5311. Write for your copy today.

P&H WELDING DIVISION

HARNISCHFEGER CORPORATION

4527 WEST NATIONAL AVE. • MILWAUKEE 46, WIS.

the P&H *Line*

P&H welding equipment is manufactured and sold in Canada by
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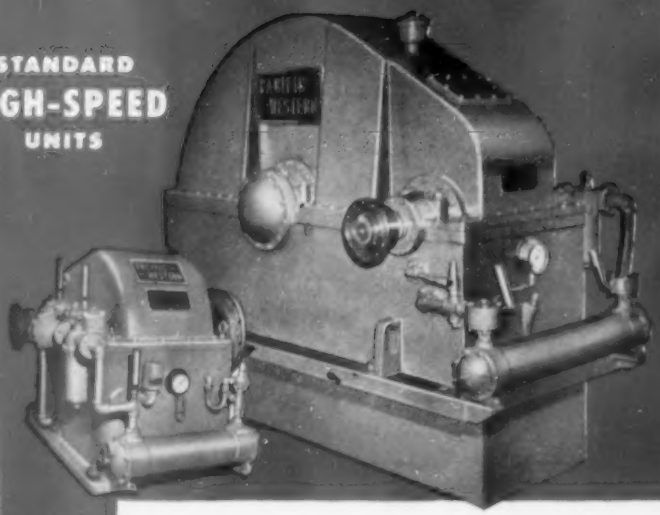
HIGH-SPEED
UNITS



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GEAR DRIVES

for every type of pumping service

Complete service to the Petroleum Industry by Western Gear Works includes the design, production, testing and application of all types of gear drives.

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Write on your letterhead for Bulletin 5204 **"Gear Drives for Pipeline Service"**

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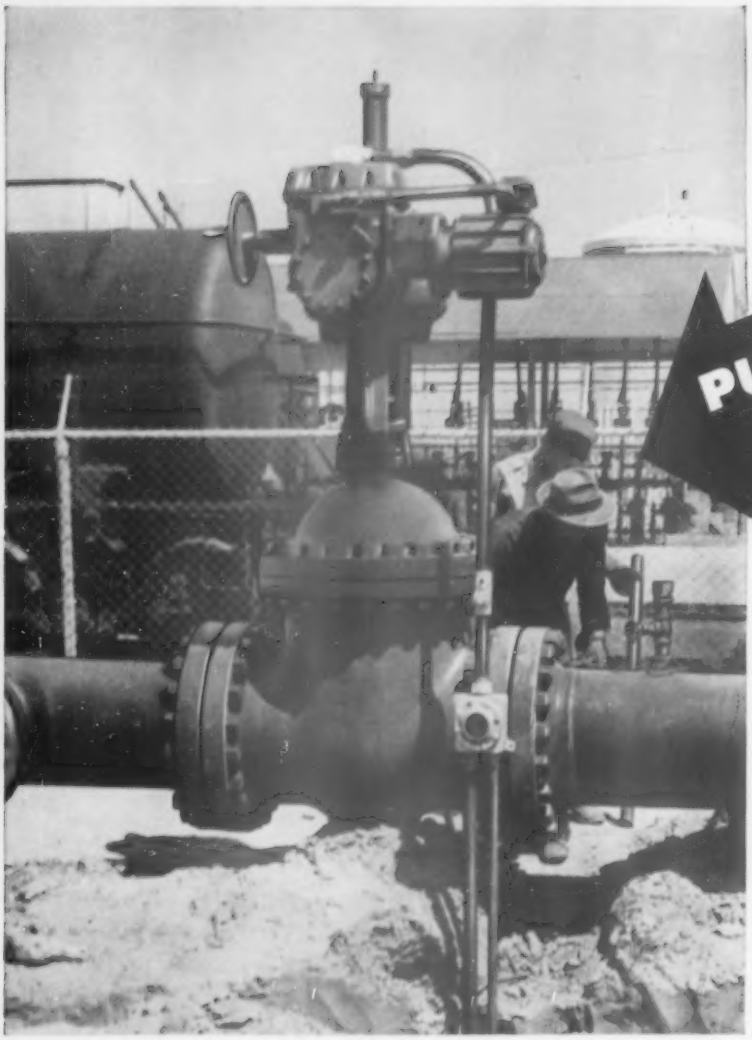


PUT IT IN... FORGET IT!

it's a Darling pipe line gate valve

Typically, this motor-operated, 18" Darling cast steel gate valve of the fully revolving, double disc parallel seat type, is now cutting costs and maintenance on a major cross-country products line.

WHEN it's a Darling pipe line gate valve you *can* forget it—for longer than you ever thought possible! Despite extreme temperature changes, despite severe line stresses, this valve closes tight every time. It requires less maintenance. You get *surer* valve performance, year in, year out.

It's all a matter of principle—a unique but simple one—*Darling's fully revolving, double disc, parallel seat* principle! It automatically compensates for valve body distortion, equalizes disc and seat wear, cuts down-time and maintenance to the bone!

Get *all* the facts—money-saving, time-saving facts that make these Darling gate valves preferred equipment today in all kinds of oil and gas line service everywhere. Simply outline your particular service needs or ask for a complete descriptive bulletin.

DARLING VALVE & MANUFACTURING CO.

Williamsport 1, Pa.

Manufactured in Canada by Sandilands Valve Manufacturing Co., Ltd., Galt 19, Ont.

FOR PLUS VALUES, JOB-PROVED AGAIN AND AGAIN

PICK BOOSTER POWER THAT NEEDS NO WATER, SLASHES OIL CONSUMPTION!

...Westinghouse 5000-hp Gas Turbine

Think what these two features alone mean to your operations! Lube oil consumption for both turbine and compressor is just a small fraction of that used by most boosters! And no cooling water is required, making it possible to put booster stations almost anywhere on the line, and greatly simplifying installation.

There are other features, too, which make Westinghouse Gas Turbines the lowest cost booster power available:

- ★ Up to 25% extra power — during winter months when demand is the greatest.
- ★ Lighter foundation — much less than for most boosters.
- ★ Simple to operate—need only one man per shift.
- ★ Inexpensive to maintain—turbine has extremely few moving parts, as much as 85% fewer than other boosters.
- ★ Single responsibility — Westinghouse integrates and sells a complete turbine-compressor booster, ready to install.

The savings these features offer you can make Westinghouse Gas Turbines a sound, low-cost choice for your next booster station. Your Westinghouse Salesman has complete data . . . call him or write: Westinghouse Electric Corporation, 3 Gateway Center, P. O. Box 868, Pittsburgh 30, Pa.

J-50571

YOU CAN BE SURE... IF IT'S Westinghouse

WESTINGHOUSE 5000 HP GAS TURBINE

Don Jenkins, Gas Turbine Sales Manager, points out two special gas turbine features which add up to big savings on gas pipeline booster operation.

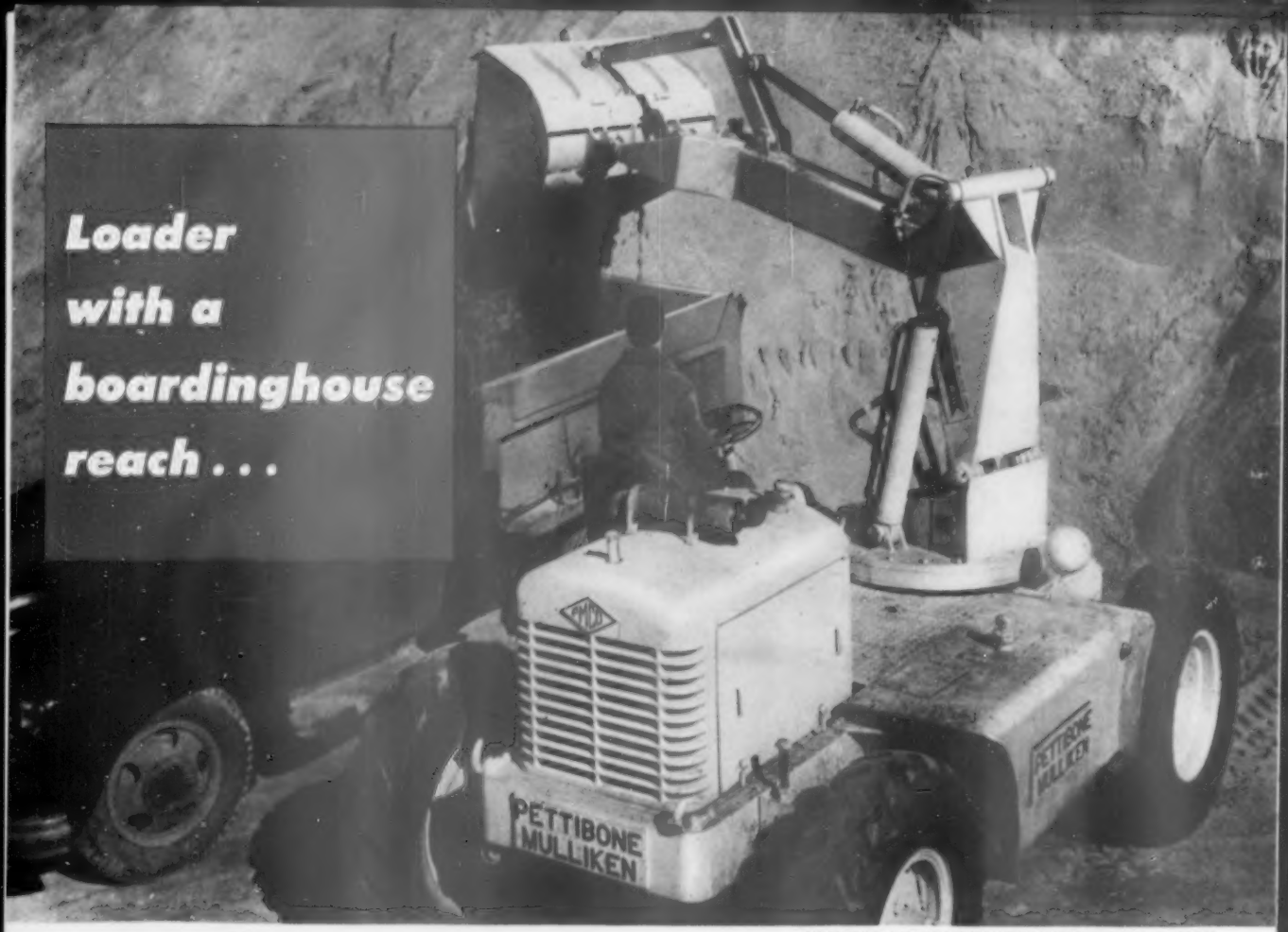


PHOTO COURTESY PETTIBONE MULLIKEN CORPORATION, CHICAGO, ILLINOIS

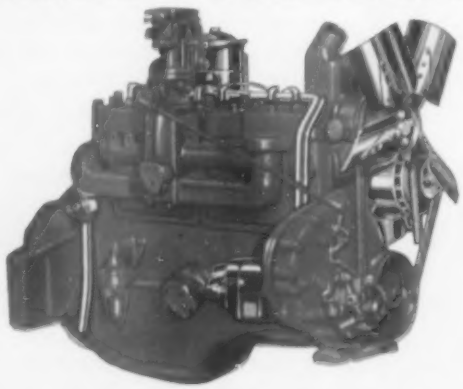
CHRYSLER *Industrial Engine and torque converter assure faster handling of tougher jobs*

This versatile, highly maneuverable loader goes after work like a stevedore after "seconds." Boom swings through 180°, loads faster, in less space, to the left or right without moving from its short, single working line. Cuts loading time up to 25%. Bucket, fork, tote hook and backfiller blade attachments are interchangeable.

Torque Converter provides extra power for tough going, faster acceleration *without* necessity of shifting gears or declutching. Furthermore, the Torque Converter eliminates shock loads to the power train . . . thus reduces maintenance.

Pettibone Mulliken Speed Swing Loaders come in two sizes . . . ¾ cubic yard and 1 cubic yard. Both sizes can be supplied with four-wheel drive (like the unit pictured), and four-wheel steer. Chrysler 230 cubic inches displacement Model 30 Industrial Engine drives the ¾ cubic yard unit, and the 265 cubic inches displacement Model Ind. 16 drives the 1 cubic yard unit. Chrysler Torque Converter connects engine with four-speed transmission, transmits power to boom.

In considering power for your equipment, remember Chrysler Power is not expensive. Production-line methods adapted to specialized industrial engine building provide a custom-built engine at mass-production prices. See a Chrysler Industrial Engine dealer or write: ***Dept. 149, Industrial Engine Division, Chrysler Corporation, Trenton, Mich.***



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INDUSTRIAL ENGINE DIVISION • CHRYSLER CORPORATION

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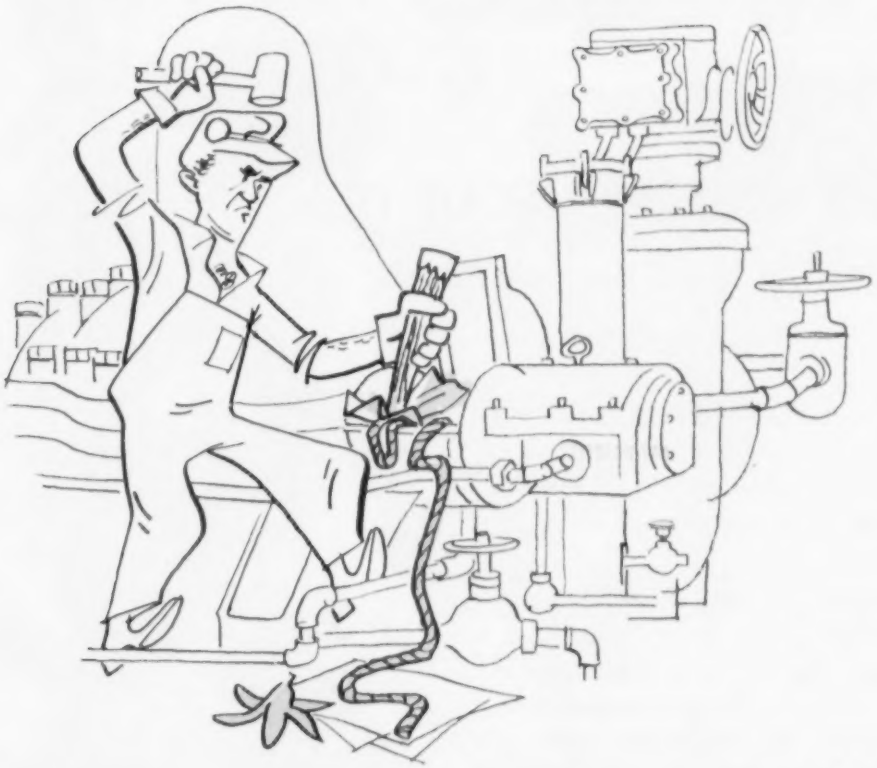
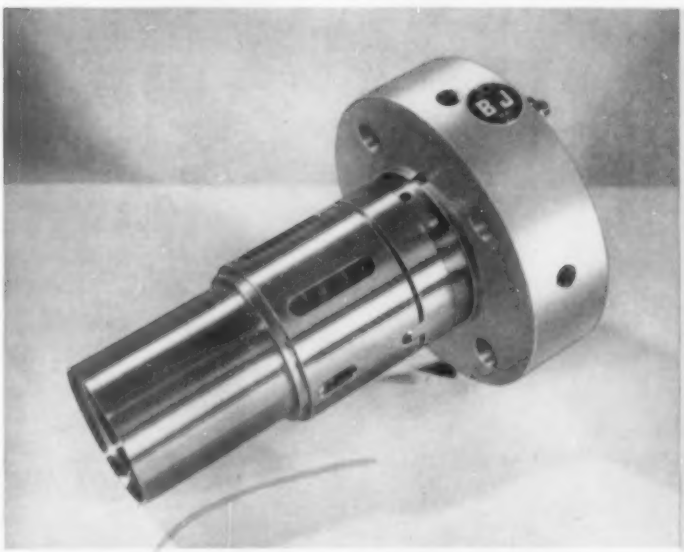
Why pack all your troubles in your old stuffingbox?



...when you can replace packing with reliable



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. . . NOR IS THERE ANY MAGIC in saving time on even the most complicated process construction job when it's in the hands of qualified men . . . Procon men.

Saving time is the logical result of a combination of factors . . . careful planning at the outset . . . engineering competence . . . broad experience that insures quick decisions, and right ones . . . proper coordination of all duties . . . a thorough knowledge and understanding of every operation involved . . . a willing acceptance of responsibilities . . . plus a sincere desire to make every hour productive to the fullest extent.

These are Procon's standards, and while the time saved will be of great value to you, it will cost you nothing extra . . . another important reason for entrusting your next process construction job to Procon.

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Super Tough

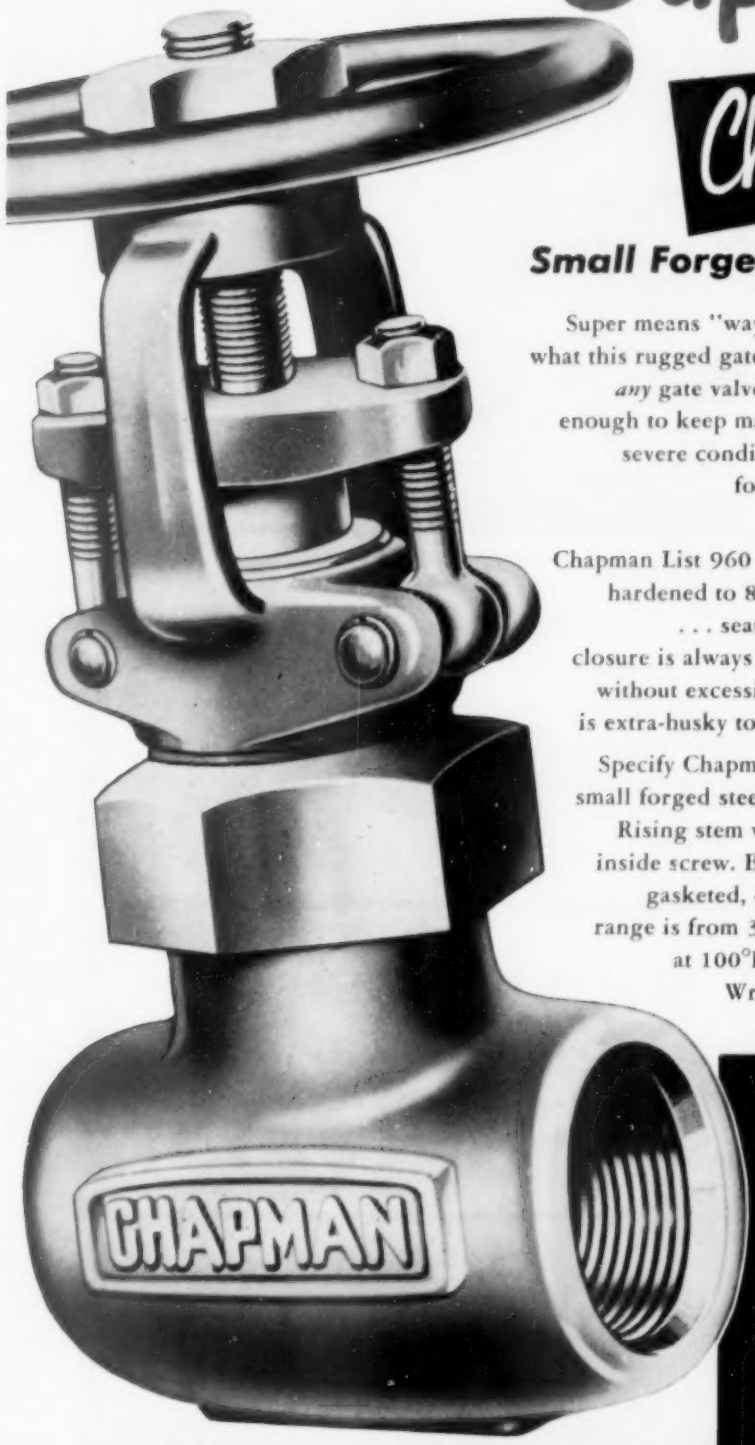
Chapman List 960

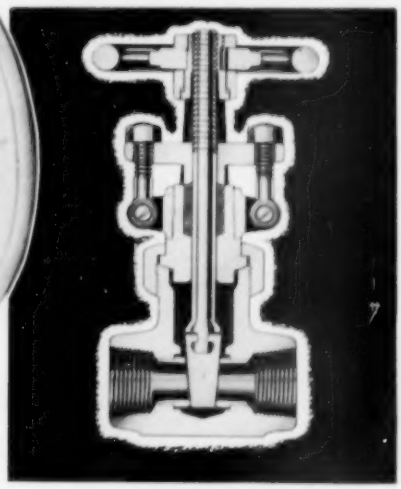
Small Forged Steel Gate Valve

Super means "way beyond the ordinary" and that's just what this rugged gate valve is . . . it's tough enough to lick *any* gate valve problem in its range . . . dependable enough to keep maintenance costs down under the most severe conditions. That's why List 960 is specified for more different applications than any other valve of its kind.

Chapman List 960 is tough because . . . wedge faces are hardened to 800 Brinell, so they won't seize or gall . . . seat rings are hardened stainless steel, so closure is always tight and operation is always smooth, without excessive wear . . . stem-and-gate connection is extra-husky to stand up under even unusual stresses.

Specify Chapman List 960 for every use you have for small forged steel gate valves. In sizes from ¼" to 2". Rising stem with yoke (shown) or rising stem with inside screw. Bonnet joint is either metal to metal or gasketed, depending upon application. Pressure range is from 380 pounds at 1000°F to 2000 pounds at 100°F. For higher ratings, specify List 990. Write today for your copy of Catalog 10.





The CHAPMAN Valve Manufacturing Co.
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KONTOL 77

An oil-soluble organic inhibitor especially designed to prevent corrosion and rust formation in products lines, tankers, pipe lines and other facilities for handling petroleum and finished petroleum products.

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Kontol 77 effectively prevents rusting caused by the presence of oxygen in finished petroleum products. It has no harmful effect on product quality. It does not affect color, octane number, accelerated gum, precipitated lead or other av-gas specifications.

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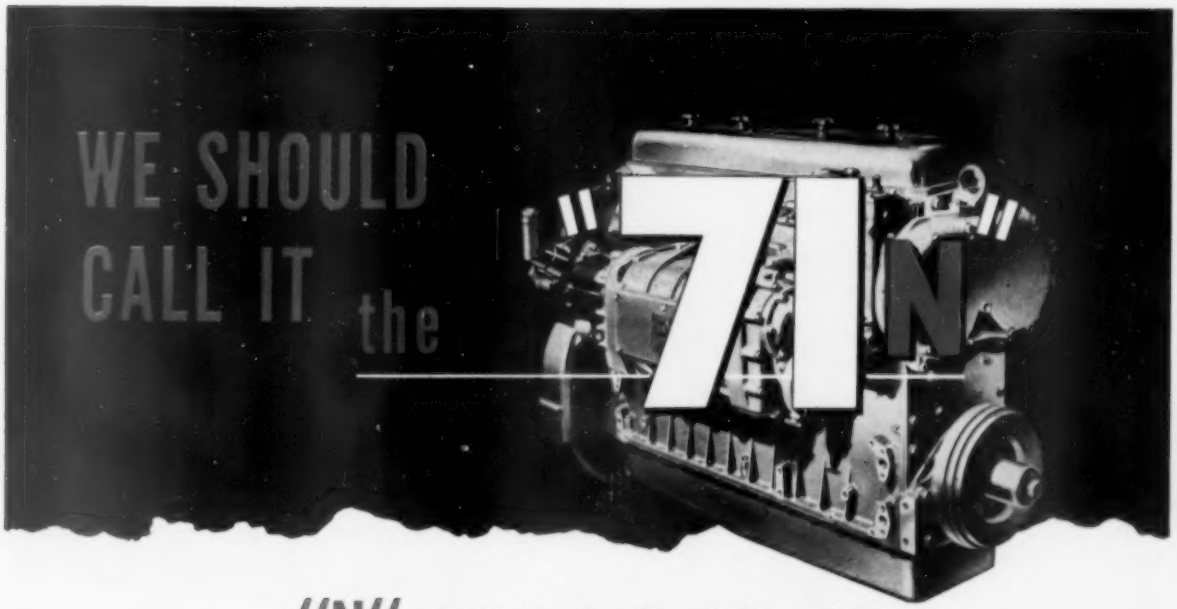

"N" FOR NEW—*New Where It Counts Most*

You don't have to be an old-timer to remember when the first General Motors Series 71 Diesel was introduced. We called it the "71" in 1938 and we call it the "71" today.

But in 17 years these design improvements from top to bottom have given operators higher horsepower, lower fuel consumption and longer engine life. And now, a whole series of new improvements has made this fast-stepping, compact, 2-cycle Diesel better than ever.

NEW **17 TO 1 COMPRESSION** gives better fuel economy, squeezing more power from every gallon of fuel.

NEW **"FIGURE 8" CYLINDER LINERS** give you a cleaner burning, more efficient engine. Air intake area is increased 32% for more complete fuel burning and better exhaust.

NEW **IMPROVEMENTS IN PISTON PIN, PIN RETAINER AND CAM FOLLOWER DESIGN** mean longer life, less maintenance cost. High-valve unit injectors last longer because the valve assembly is away from high cylinder temperature areas. Hard-chrome steel "Lite-Tite" piston rings resist wear; are tougher and more flexible and give many more hours of service.

And—best of all—in your next overhaul you can incorporate any or all of these new improvements in any GM Series 71 Diesel engine you're operating today. "The Inside Story" tells you how these new improvements can help cut your costs and speed your jobs. Mail the coupon today for your copy.

DETROIT DIESEL ENGINE DIVISION
GENERAL MOTORS • DETROIT 28, MICHIGAN
Single Engines . . . 30 to 300 H.P. • Multiple Units . . . Up to 893 H.P.

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General Motors Corporation
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Please send me booklet "The Inside Story"

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Position: _____
Company: _____
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Composite photo of one torch and jet mixer with three different welding tips: 13, 7 and 1.
two new reasons
why the AIRCO 800 is the...
MOST VERSATILE TORCH YOU CAN BUY
2. NEW JET MIXER
1. NEW CUTTING ATTACHMENT

The Airco Style 800 torch will handle any welding, heating or cutting job, thanks to the brand new Airco Jet Mixer and two completely redesigned cutting attachments.

The new Jet Mixer gives you perfectly stable flame control with all gas flows. Cyclonic action swirls the gases together, mixing them completely, within a tip size range from 0 to 14 inclusive. Rubber gas sealing rings provide a gastight seal with hand tightening, no wrench required . . . saves time in tip changes.

New heavy-duty cutting attachment takes all standard tips; cuts steel up to 8" thick! Medium-duty attachment available for lighter service. Both have rubber gas sealing rings, plus mixers which can be easily removed for cleaning, if necessary.

Owners of Style 800 torches can use the new Jet Mixer and cutting attachments with their present torches. For details, write to Air Reduction or see your Airco dealer, asking for your copy of Catalog 818, "Hand torches for gas welding and cutting."

AIR REDUCTION

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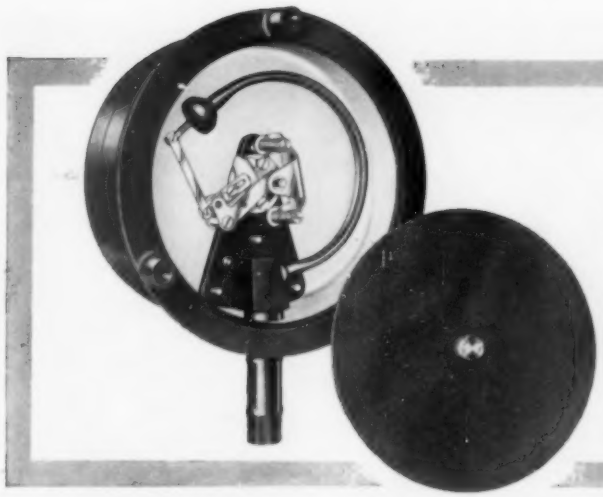


EASY TO SERVICE...

a plus value of ASHCROFT *Maxisafe* DURAGAUGES

Turn the knob on the back of the *Maxisafe* and the plate comes off, fully exposing the entire mechanism for fast and easy inspection, recalibration or adjustment. This time and money-saving feature is highly favored wherever Ashcroft *Maxisafe* Duragauges are in service.

This Duragauge was named *Maxisafe* because it has an integrally-cast wall to separate the dial from the movement and Bourdon Tube assembly — a solid wall of safety that protects the viewer if the tube ever ruptures. Covering the back of the case is a double spring mounted safety release plate — a Teflon-coated plate tightly fitted on a rubber gasket and held in place by a knurled knob. Less than 0.5 psi pressure created by a ruptured tube forces this cover open — vents the discharge safely to the rear.

The Maxisafe is available in 4½", 6" and 8½" dial sizes. You can have a choice of standard Ashcroft Duragauge pressure ranges, case designs (except Types 1179 and 1279), and mountings. Get the utmost in sustained accuracy, durability, protection and convenient servicing. Specify Ashcroft *Maxisafe* Duragauges.

YOUR INDUSTRIAL SUPPLY DISTRIBUTOR has complete facts about Ashcroft Gauges of all types. You can depend on his knowledge and experience to help you satisfy every requirement of the application. He maintains local stocks to serve you promptly and economically.

1850 ASHCROFT U.S.A.

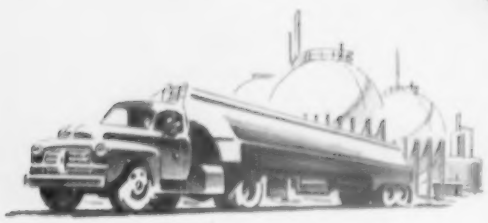
ASHCROFT GAUGES

A product of **MANNING, MAXWELL & MOORE, INC.** STRATFORD, CONNECTICUT

MAKERS OF 'ASHCROFT' GAUGES, 'AMERICAN' AND 'AMERICAN-MICROSEN' INDUSTRIAL INSTRUMENTS, 'HANCOCK' VALVES, 'CONSOLIDATED' SAFETY AND RELIEF VALVES, AIRCRAFT PRODUCTS. BUILDERS OF "SHAW-BOX" AND 'LOAD LIFTER' CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES.

EATON 2-SPEED AXLES

Cut Costs for Truckers Six Ways



More than Two Million
Eaton Axles in Trucks Today!
Ask your truck dealer
for complete information.

1. Quicker full load trips, on or off the highway.
2. Wider range of vehicle usefulness.
3. Reduced wear on engine and power transmitting parts; less maintenance.
4. Maximum "earning" time on the job; less "expense" time in the shop.
5. Fewer stops for gas and oil; lower operating cost.
6. Extra thousands of low cost, trouble-free miles in the life of the truck.

EATON — AXLE DIVISION —
MANUFACTURING COMPANY,
CLEVELAND, OHIO

PRODUCTS: Sodium Cooled, Poppet, and Free Valves • Tappets • Hydraulic Valve Lifters • Valve Seat Inserts • Jet Engine Parts • Rotor Pumps • Motor Truck Axles • Permanent Mold Gray Iron Castings • Heater-Defroster Units • Snap Rings Springtites • Spring Washers • Cold Drawn Steel • Stampings • Leaf and Coil Springs • Dynamatic Drives, Brakes, Dynamometers

Performance Proves 3-BLADE Wall Scraping With Grant Is Best For Your Job!

To enlarge hole for better cementing . . . to make pockets for gravel packing . . . to enlarge short tight spots before casing is run . . . to scrape the producing zone for better oil flow — there's nothing that out-performs the Grant 3-Blade Wall Scraper . . . *and here's why:*

3-BLADE CONTACT with the formation gives stability and smoothness you won't find in similar tools, prevents "torquing up" and reduces strain on both pipe and surface equipment.

FULL CIRCULATION to bottom (no internal by-pass) with this tool insures adequate fluid volume and pressure at the diamond point or bull-nose for fast removal of cuttings.

HYDRAULIC BLADE OPENING, accomplished by controlled pump pressure, expands blades uniformly through the opening cycle, allows automatic retraction on release. All blades work as a unit.

NON-CLOGGING BLADES and blade recesses require no circulation for cleaning, thus put pump volume where it's needed — *removing cuttings.*

THICK, WIDE BLADES and simple, heavy construction top to bottom make the Grant trouble-free and insure smooth, fast and efficient scraping on the toughest jobs.

For all your wall scraping jobs, the Grant is made in a complete range of sizes to give you the right tool for the work.

Either bull-nose or diamond point ends available.

For the performance you want — *always call Grant!*

Grant Bulletin No. 60 describes the 3-Blade Wall Scraper in detail. Send for your free copy today.

GRANT

OIL TOOL COMPANY

Main Office & Plant

2042 E. Vernon Ave., Los Angeles 58, California

Cities Service goes for high stakes...

Test wells are put down on an average of one every 4 days by

CITIES SERVICE

A Growth Company

THROUGH SNOW OR RAIN OR HEAT OR SAND . . .

On Guard!

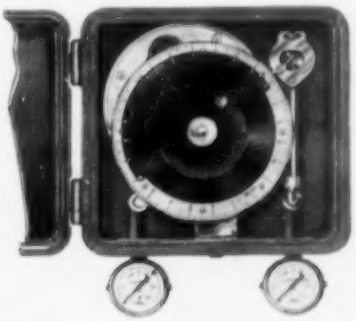
FISHER® INTERMITTERS

SPECIALLY DESIGNED FOR OIL FIELD PRODUCTION WORK, FOR INTERMITTENT GAS LIFT OPERATION OR INTERMITTENT FLOW CONTROL ON FLOWING WELLS.

THE NEW TIMING UNIT is housed in weather-proof, yoke mounted case—has the inherent ruggedness so essential for satisfactory field operation. An economical unit.

NEWLY DESIGNED VALVE, specially designed for intermitter production control work. 2" screwed globe "Q" body, 1500 PSI cold working pressure.

THE NEW FISHER INTERMITTERS are designed and built with economy in mind. They provide both lower first costs with greater operating economy.



FEATURES:

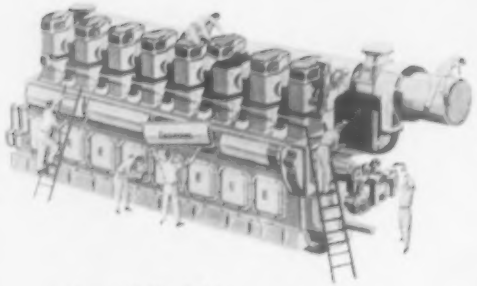
1. Non-bleed pilot.
2. Minimum timing period 1½ minutes with 24-hour spring wound clock.
3. Large diameter wheel with movable clips for adjusting time cycle.
4. Easy replacement of parts subject to wear. No special tools needed.

FISHER

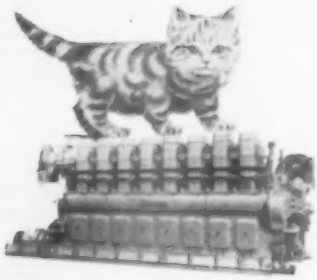
FISHER GOVERNOR COMPANY • Marshalltown, Iowa

LEADS THE INDUSTRY IN RESEARCH FOR GAS PRESSURE CONTROL

A really efficient cooling system? No "hot spots" with ENTERPRISE –it never runs too hot or too cold!



Accessibility? It's easy to get to *all* the parts!



Low "noise level" and freedom from damaging vibration? ENTERPRISE Diesels are "quiet as a kitten"!

Mr. Diesel Engine Buyer:

What Do You Look For In A Diesel?

Sustained, continuous and economical performance ...hour after hour, year in and year out!

This is what you want in your next diesel engine. And this is what you will *get* with dependable ENTERPRISE Diesels.

Some of the key features that combine to make ENTERPRISE your best buy in heavy-duty diesels are shown here. There are many others you'll want to know about – up to the minute features of design, materials and construction that are the result of 35 years experience in power research and diesel engine building ... features that contribute to the most efficient and reliable power available at a fraction of the cost you'd expect.

Your own comparison will prove that there is no finer diesel. Write for complete information on ENTERPRISE ... *the choice of power experts.* Units from 75 to 2700 hp.

More hours per gallon of lube oil? Every gallon goes further with ENTERPRISE!

True balance for smooth running? ENTERPRISE takes the "jitters" out of diesel operation!

Top service ... where and when you want it? ENTERPRISE customers get fast service ... and parts within hours!

Enterprise DEPENDABLE Diesels

18th and Florida Streets
San Francisco 10, California

ENTERPRISE ENGINE & MACHINERY CO.

A Subsidiary of GENERAL METALS Corporation

Boston • Chicago • Denver • Kansas City • Los Angeles
Minneapolis • New Orleans • New York • San Diego
San Francisco • Seattle • St. Louis • Washington, D.C.

DIESEL ENGINES • OIL BURNERS • PROCESS MACHINERY

Motorists: here's proof...

Gulf's cleaner-burning, super-refined gasoline solves today's No. 1 engine problem!

This lamp is burning the "DIRTY-BURNING TAIL-END" of gasoline which GULF refines out
This lamp is burning NEW SUPER-REFINED GULF NO-NOX, the cleaner-burning super-fuel

Laboratory tests promised...

. . . these *immediate* and *lasting* benefits from this new, super-refined fuel:

More complete engine protection than from the so-called "miracle-additive" gasolines. Why? Because Gulf refines *out* the "dirty-burning tail-end" of gasoline (the No. 1 troublemaker in high-compression engines)—and then treats this new Super-Refined NO-NOX to give it a *complete range of protective properties*. It protects *every* part it touches against carbon, rust, gum.

Extra gas mileage in all your everyday, short-trip, stop-and-go driving.

No knock, no pre-ignition. Why? Because the anti-knock power of new Gulf NO-NOX has been stepped up to an all-time high.

Stall-proof smoothness. Instant *starts*, too—and fast, fuel-saving warm-up.

That's why new Super-Refined Gulf NO-NOX gives your engine more power-with-protection than you've ever known.

Road tests proved...

These cars, powered by New Gulf No-Nox, actually performed better than new . . . after 15,000 miles!

True! After 15,000 miles per car—covering all conditions of city and country driving—Gulf test cars showed these results:

- Higher-than-new horsepower!
- Better-than-new on gasoline mileage!
- And not a single trace of carbon knock or pre-ignition at any time—even on the steepest mountain grades!

COMPLETELY NEW! SUPER-REFINED

New Gulf No-Nox

THE HIGH-EFFICIENCY GASOLINE

It's Time to

ALLIS-CHALMERS
PROGRESS IN
Switchgear

MODERNIZE

Allis-Chalmers unit substations improve safety . . . save space . . . improve appearance. They are easy to specify and easy to install.

Individually enclosed low voltage air circuit breakers like this have wide application in industry for protection of motors, lighting circuits, and transformers.

Metal-clad switchgear provides safe, compact control and circuit protection. Special circuit schemes in standard structures can be provided to assure uninterrupted power.

ALLIS-

ELECTRICALLY

with Allis-Chalmers Switchgear

when voltage is low

Low voltage at motors is usually caused by overloaded feeders or long runs of low voltage cable. Undervoltage reduces motor torque; increases production time on machine tools; increases time required by heating elements.

when space is limited

Older types of switchgear often use critical production floor space. Replace with compact Allis-Chalmers switchgear. It fits anywhere . . . on the roof . . . on a balcony . . . in the basement . . . or outside near the building.

when cable runs are long

Long low voltage cable runs are wasteful. Savings realized by elimination of long low voltage feeders include cable cost, installation cost and cost of power lost. These savings alone will often justify modern Allis-Chalmers load center unit substations.

when relocation costs are high

Equipment relocation costs are sometimes excessive. Savings in relocation costs due to product changes or production modifications can be made by using Allis-Chalmers switchgear, bus duct and unit substations. Everything is salvageable!

when automation is used

If automation or other continuous processing is used, power interruptions cannot be tolerated. Standard Allis-Chalmers metal-clad switchgear is designed to accommodate special circuit schemes, such as ring bus and transfer bus, to assure uninterrupted flow of power.

when load growth is fast

System capacities now exceed breaker ratings in many plants. Breakers have become obsolete due to increased use of power. These breakers may be inadequate to handle a short circuit, with resulting possible danger to plant personnel and equipment.

Let experienced Allis-Chalmers switchgear engineers help you solve your distribution problems. Call your nearby Allis-Chalmers district office, or write Allis-Chalmers, Milwaukee 1, Wisconsin.

Allis-Chalmers
Milwaukee 1, Wis.

Please send me New Load Center Substation Booklet 11B6285B.

Name

Title

Firm

Street

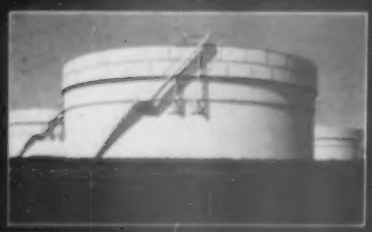
City State

A-4247

A-C ALLIS-CHALMERS

CHALMERS

GRAVERSPHERES are used to store natural gasolines and volatile liquids including butane, butadiene, etc. They are ideal for storing gases—sustaining pressures up to 100 psi. and greater. Capacities range from 500 to 20,000 bbl.

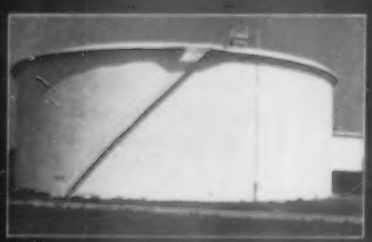


GRAVER EXPANSION ROOF TANK eliminates breathing losses and minimizes filling losses. Its positive liquid seal, exclusive with Graver, protects under all conditions. Ideal for converting existing tankage, and simple to maintain, the Expansion Roof Tank may well protect an entire terminal.

there is a GRAVER *CONSERVATION DESIGN to fit every need!*

Graver manufactures a number of conservation designs allowing you to specify what suits your exact needs. Thus your tankage can be "tailor-made" to obtain optimum efficiency and maximum economy in operation. For authoritative assistance with your conservation problems, consult your nearest Graver Sales Engineer.

GRAVER VAPOR-MIZER is an economical design that conserves vapors, using less steel in building and requiring smaller vapor lines in manifolded tankage.
The VAPOR-MIZER helps maintain the fresh quality of your product! As it operates at very low pressures, the reinforcement of manifolded tanks becomes unnecessary.



GRAVER DOUBLE-DECK AND CENTER-WEIGHTED FLOATING ROOF TANKS are two separate designs in which the roof floats directly on the liquid, preventing the formation of vapors. They are applicable to crude and product storage areas at refineries, terminals and large bulk installations.

GRAVER

tank fabricators for 97 years

GRAVER TANK & MFG. CO., INC.

East Chicago, Indiana

NEW YORK • CHICAGO • PHILADELPHIA • ATLANTA • DETROIT • CLEVELAND
PITTSBURGH • HOUSTON • CATASAUQUA, PA. • SAND SPRINGS, OKLA.
CASPER, WYO. • ODESSA, TEXAS • LOS ANGELES • EDGE MOOR, DEL.
TULSA • SAN FRANCISCO • FONTANA, CALIF.

No maintenance problems with this instrument!

In spite of all of the development work being done on automatic control instruments, the Bristol Series 500 Air-Operated Controller is still the most dependable and trouble-free — as proved by thousands of installations. And here's why:

It's the simplest to service. Only one adjustment with a ¼ in. wrench calibrates the control system. No other adjustment is needed. Control system can be completely disassembled and, after reassembly (even with replacement parts), can be *exactly calibrated by this one simple adjustment.*

It's completely reliable. One user states, "I'm amazed at the way this instrument performs day-in and day-out with little or no attention. We call it the work-horse controller in our plant. And our plant men like to use it, because it gives them the precision results they need without having to fuss with it".

Its settings are exactly reproducible. Reset rate, derivative time, and proportional band adjustments are accurately calibrated and exactly reproducible. You can instantly reproduce established settings without cut and try.

It uses the world-famous Bristol measuring elements. The measuring systems used in Bristol Series 500 Air-Operated Controllers for TEMPERATURE, PRESSURE, FLOW, VACUUM, DRAFT, ABSOLUTE PRESSURE, LIQUID LEVEL, pH, AND HUMIDITY are the result of 65 years of experience in instrument making and application in practically every industry. Bristol measuring elements are recognized the world over for their accuracy, simplicity, and reliability. There just aren't any better measuring elements made than Bristol's.

For more facts and figures about the Series 500 Air-Operated Controllers, write for free 32-page bulletin A120. The Bristol Company, 120 Bristol Road, Waterbury, Connecticut.

4.27

BRISTOL'S

BRISTOL

POINTS THE WAY IN HUMAN-ENGINEERED INSTRUMENTATION

AUTOMATIC CONTROLLING, RECORDING AND TELEMETERING INSTRUMENTS

Do you have this MARVEL Inverse Oiler on your { GASOLINE / BUTANE / or / DRY GAS } engine?

then you should use this MARVEL MYSTERY OIL in the Oiler!

Here's a carefully engineered pair to improve performance of any engine . . .

The *Marvel Inverse Oiler* is designed to feed *Marvel Mystery Oil* in exact proportion to engine speed and load. Prevents excess wear on valve stems and guides . . . keeps upper piston rings free to move in their grooves . . . retards ring flutter . . . and cushions ring pounding which can result in ring breakage. In addition, *Marvel Mystery Oil* reduces cylinder wall wear, and gives assurance against valves sticking. Remember, it is *the oil* which must do these things and only *Marvel Mystery Oil* is blended for this purpose and for this oiler. Over 30 years of exceptional performance.

This Chart shows the proper setting for constant load engines

BRAKE H. P. AT BELT	NAT. GAS CU. FT. PER HOUR	BUTANE GALLONS PER HOUR	GASOLINE GALLONS PER HOUR	M. M. OIL DROPS PER MIN.	M. M. OIL HOURS PER QUART
10	115.	1.07	1.12	4	228
15	172.5	1.60	1.68	6	152
20	230.	2.14	2.24	8	114
25	287.5	2.67	2.80	10	91
30	345.	3.21	3.36	12	76
35	402.5	3.74	3.92	14	65
40	460.	4.28	4.48	16	57
45	517.5	4.81	5.04	18	50
50	575.	5.35	5.60	20	45
60	690.	6.42	6.72	24	38
70	805.	7.49	7.84	28	32
80	920.	8.56	8.96	32	28
90	1035.	9.63	10.08	36	25
100	1150.	10.70	11.20	40	22
120	1380.	12.84	13.44	48	19
140	1610.	14.98	15.68	56	17
160	1840.	17.12	17.92	64	14
180	2070.	19.26	20.16	72	12
200	2300.	21.40	22.40	80	11
225	2587.5	24.00	25.20	90	10
250	2875.	26.75	28.00	100	9
275	3162.5	29.42	31.10	110	8
300	3450.	32.10	33.60	120	7

EXAMPLE:—If you use 805 cu. ft. of dry gas, 7.49 gallons of butane or 7.84 gallons of gasoline, your H.P. is about 70, so adjust oiler to feed 28 drops per minute. You will then receive about 32 hours per quart of MARVEL MYSTERY OIL.

If engine load increases after setting for normal load, oiler will automatically increase its feed, or decrease its feed when load is lessened.

When more than one oiler is used

To determine drop count per oiler when more than one oiler is used on an engine—divide recommended drop count by number of oilers.

NOTE: Guarantee on oiler is void if any other oil than MARVEL MYSTERY OIL is used therein. Some *engines* also carry this guarantee policy.

See Your Local Jobber or Oil Well Supply House

EMEROL MFG. CO. Dept. 373, 242 West 69th Street, New York 23, N. Y.

where miles are long and "DOWN" TIME is real money!

HERE'S one of the Northwests owned by Williams Brothers of Tulsa, Oklahoma on a pipeline job in North Dakota. Williams Brothers have owned twelve Northwests, and Williams Brothers is just one of the many pipeline contractors that Northwests are serving.

Such outfits as Williams Brothers, Brown & Root, Inc., R. H. Fulton and many more, have found that Northwest equipment brings them the proved ability to meet the many varied problems of pipeline service. They have been proved in miles of travel. They are rugged and stand up in the rock cuts. Where pipe and valves must be handled they bring the smooth, accurate operation of the "Feather-Touch" Clutch Control (no complicated, delicate mechanisms, pumps or compressors), Uniform Pressure Swing Clutches eliminate the grabs and jerks of swinging and the time lost in inaccurate spotting of loads. They are easily converted in the field from Pullshovel to Crane, Dragline or standard Shovel.

Here is a machine that has given literally *miles* of service with freedom from down time in the far off places where pipelines take you. It's a proved pipeliner!

Before buying your next machine get the full story about Northwest.

NORTHWEST ENGINEERING CO.
1517 Field Building
135 South LaSalle St., Chicago 3, Ill.

NORTHWEST

CRAWLER and TRUCK MOUNTED SHOVELS • CRANES • DRAGLINES • PULLSHOVELS

NORTHWEST ENGINEERING COMPANY
135 South La Salle Street, Chicago 3, Illinois

Please send me complete information and catalogs on equipment as checked:

☐ Shovel ☐ Crane ☐ Dragline ☐ Pullshovel

☐ Truck Crane Capacity_____

Name_____

Address_____

Town_____ Zone____ State____

Signed_____

Fight Corrosion

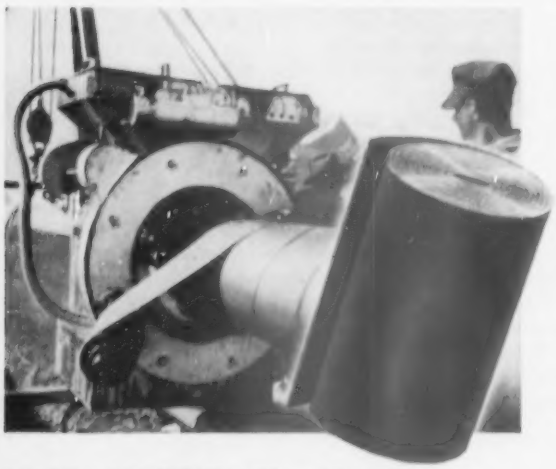
with these

Johns-Manville Pipe Protection Materials

...cut maintenance expense
increase pipe life

TRANSHIELD Asbestos Felt—

This newly developed low cost pipe line protecting wrapper is designed for average soil conditions. It is reinforced with continuous glass yarns, parallel spaced on ¼" centers to give tear-free application strength. Made of coal-tar saturated asbestos, it acts as a continuous barrier to shield pipe line enamels from earth loads and soil stresses.



15-LB. ASBESTOS Pipe Line Felt—

A heavy-duty material particularly suitable for severe soil conditions or where a heavier material than J-M Transhield is desired. Provides long life, toughness, flexibility, resistance to rot, decay, cracking, and impact. J-M 15-lb. Asbestos Felt now protects more than 100,000 miles of oil and gas pipe lines. Widths 2" to 36". Rolls any length desired.

TRANTEX® Polyvinyl Tape—

A widely used coating where ease of application is important . . . over field welded joints of mill-wrapped pipe . . . for rush coating needs. Pressure-sensitive . . . sticks to pipe on contact, forming a firm stable bond. Can be cold-applied by hand or with simple wrapping machines. In rocky soils, an outer wrap of J-M Transhield or J-M 15-lb. Asbestos Pipe Line Felt is recommended.

For further information about Johns-Manville Products for Pipe Line Protection, write to Johns-Manville, Box 60, New York 16, N. Y.; in Canada, 199 Bay St., Toronto 1, Ont.

JOHNS-MANVILLE JM PRODUCTS

Johns-Manville PRODUCTS FOR PIPELINE PROTECTION

Selectivity

The polar molecule is highly selective in its solvent action permitting ready extraction of the "undesirable" constituents of petroleum oil.

Productivity

The furfural operation produces high yields of quality oil.

Availability

Production from a variety of agricultural residues makes ample quantities available the year 'round.

Stability

Furfural is thermally stable under conditions of use.

Recovery

Furfural is readily recovered. The experience of over 40 plants using furfural proves that solvent losses are low.

Versatility

The large variety of furfural-processed petroleum products range from lube oils to catalytic cracker recycle stock. A related technique, extractive distillation, is applicable to other petroleum products such as the separation of C_4 hydrocarbons.

Separability

High density together with low surface tension permit rapid phase separation.

Handling

The low freezing point of -34°F. assures trouble-free handling throughout the year—unclogged lines in winter.

Health Factor

Years of use in the petroleum industry show that furfural may be handled safely without injury to those working with it.

For a further check into the physical side of QO Furfural, write for Bulletin 203.

The Quaker Oats Company CHEMICALS DEPT.

339Q The Merchandise Mart, Chicago 54, Illinois
Room 539Q, 120 Wall St., New York 5, N. Y.
Room 439Q, P. O. Box 4376, Portland 8, Oregon

In the United Kingdom: Imperial Chemical Industries Ltd., Billingham, England
In Europe: Quaker Oats-Graanproducten N. V., Rotterdam, The Netherlands; Quaker Oats (France) S. A., 3, Rue Pillet-Will, Paris IX, France
In Australia: Swift & Company, Pty., Ltd., Sydney • In Japan: F. Kanematsu & Company Ltd., Tokyo

In the 3000-cu. in. displacement class...

You get *more for your*

As an engine expert, **YOU** be the judge

This simple checklist lets you prove it yourself

Does it have this as standard?	Le Roi L3000	Engine "A"	Engine "B"	Engine "C"	Engine "D"	
1. Modern V-Type Construction	Yes	No	No	Yes	No	
2. Light-weight Cam-Ground Aluminum Pistons	Yes	No	No	No	No	
3. Maximum Operating Speed	1200	900	1200	1200	1000	
4. Piston Speed at Maximum Continuous-Duty Speed	1400	1275	1750	1400	1500	
5. Guided Valve Mechanism Full Length	Yes	No	No	No	No	
6. Full-Flow Filters	Yes	No	No	No	No	
7. Full-Precision Bearings	Yes	Yes	Yes	Yes	Yes	
8. Overall Length — Inches	100"	110"	113"	117"	115"	
9. Dual Water Circulation Pumps	Yes	No	No	No	No	
10. Balanced Intake Manifolds with Single Carburetor	Yes	Yes	Yes	No	Yes	
11. Crankshaft Vibration Dampener	Yes	Yes	Yes	No	No	
12. Counter-balanced Crankshaft	Yes	No	No	No	No	
13. Sectional Water-Cooled Manifolds	Yes	Yes	No	Yes	Yes	
14. Weight per HP Based on Continuous Duty Rating	32.9	46.0	41.4	45.3	42.0	

THERE'S no doubt about it — you *do get more for your money* in a Le Roi L3000.

And not only does the L3000 give you more of everything you want *as standard equipment* — it also gives you the lowest cost per hp of any 3000-cu. in. engine of this type! That's why you see this modern engine at work in so many places in the oilfields.

See what the L3000 can do for *you*. Talk it over with your supply house or Le Roi distributor.

LE ROI

LE ROI COMPANY

A Subsidiary of Westinghouse Air Brake Co.
MILWAUKEE 14, WISCONSIN

Plants: Milwaukee • Cleveland—Greenwich—Dunkirk, Ohio • Coldwater, Mich.
Oilfield Headquarters: Tulsa, Oklahoma

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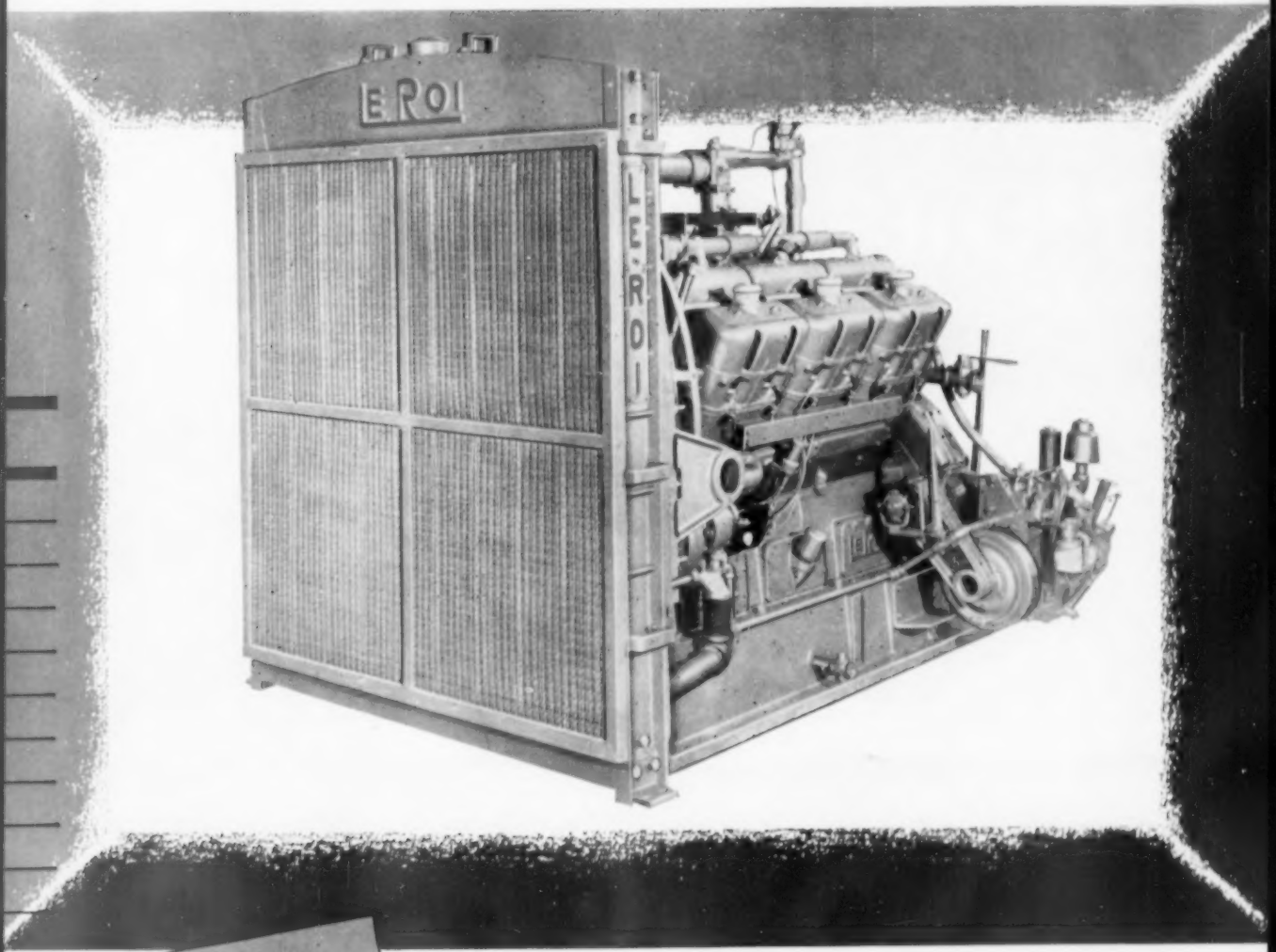
money in a LeRoi L3000



OILFIELD SALES-SERVICE NETWORK

Oklahoma
La Roi Company Branch — Tulsa
Carson Machine & Supply Co. — Oklahoma City

East & South Texas, Gulf Coast
Southern Engine and Pump Company — Houston, Kilgore, Edinburg, Dallas, San Antonio, Corpus Christi, Texas, and Lafayette, Houma, New Orleans, Louisiana.

North & West Texas, New Mexico
General Machine & Supply Co. — Odessa, Snyder, Texas.
Nortex Engine & Equipment Co.—Wichita Falls, Texas.

Kansas
Carson Machine and Supply Co.—Great Bend

Rocky Mountain Area
Gehring Equipment Co. — Casper, Wyoming, Rangeley, Col.

Mississippi, Arkansas and Northern Louisiana
Ingersoll Corporation — Shreveport, Louisiana, El Dorado, Arkansas and Clarksdale, Jackson, Mississippi.

West Coast
Le Roi Engine Sales Co. — Long Beach, California

Appalachian Area
P. C. McKenzie Co., Pittsburgh, Bradford.

Canada
Lucey Export Ltd. — Calgary, Edmonton, Alberta.

Another of HILL, HUBBELL's "Things That Money Can't Buy."

"Practice makes perfect" is an axiom proved by the many Hill, Hubbell men who have been "on the job" for years and years—gradually acquiring a know-how that spells the difference between superior and mediocre results. Add the years of their executive and supervisory experience together! You get a total which explains, in part, the unquestioned leadership of America's "pioneers in pipe protection."

HILL, HUBBELL and COMPANY

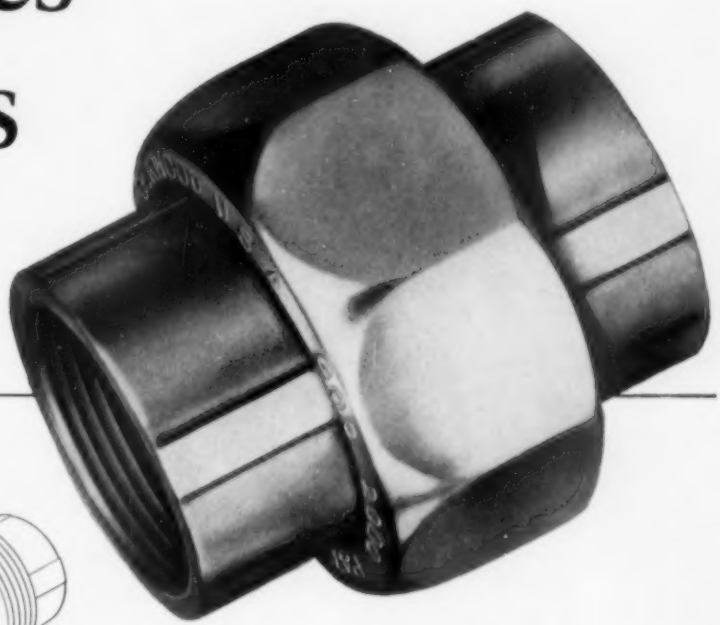
Factory Applicators of Pipe Coatings and Wrappings

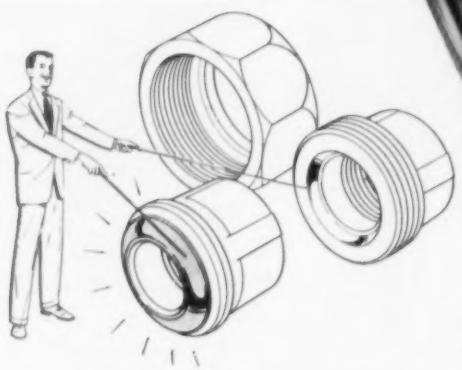
DIVISION OF GENERAL PAINT CORPORATION

3091 Mayfield Road • Cleveland 18, Ohio

LEADER IN PIPE PROTECTION FOR MORE THAN A QUARTER CENTURY

Unique performance
of new Rockwood Union #603
amazes users





No galling in "making up"!

"There's no other Union like it!" users tell us.

And they're quite right.

No other Union has the hardness-differential that makes Rockwood's remarkable new Union #603 unique. *The male seat of this new Union is specially treated to give it a greater degree of hardness than the female seat.* Result: no galling in "making up" — longer service.

Users find that this hardness-differential, coupled with the many other Rockwood features, brings them Union performance unheard of before. They also praise these additional Rockwood advantages —

- V exclusive cold forging process that results in higher resistance to tough working conditions
- V absolutely interchangeable parts
- V plug type ball-to-cone design that eliminates sharp corners or edges, does away with scratching when making up in tight places
- V exclusive "Rockwoodizing" that protects entire Union, including threads, against corrosion

Both seats of the new Union #603 are made of corrosion-resistant AISI molychrome steel, forged in place and bonded-locked under 100,000 and 400,000 pound pressure.

If you have not already started using this remarkable new Union, plan now to do so. For complete facts, mail coupon today.

ROCKWOOD SPRINKLER COMPANY
WORCESTER 5, MASSACHUSETTS

ROCKWOOD SPRINKLER COMPANY
629 Harlow Street
Worcester 5, Mass.

Please send me prices and further data on the new Rockwood Union #603. I would also like the name of the nearest Rockwood distributor.

Name.....

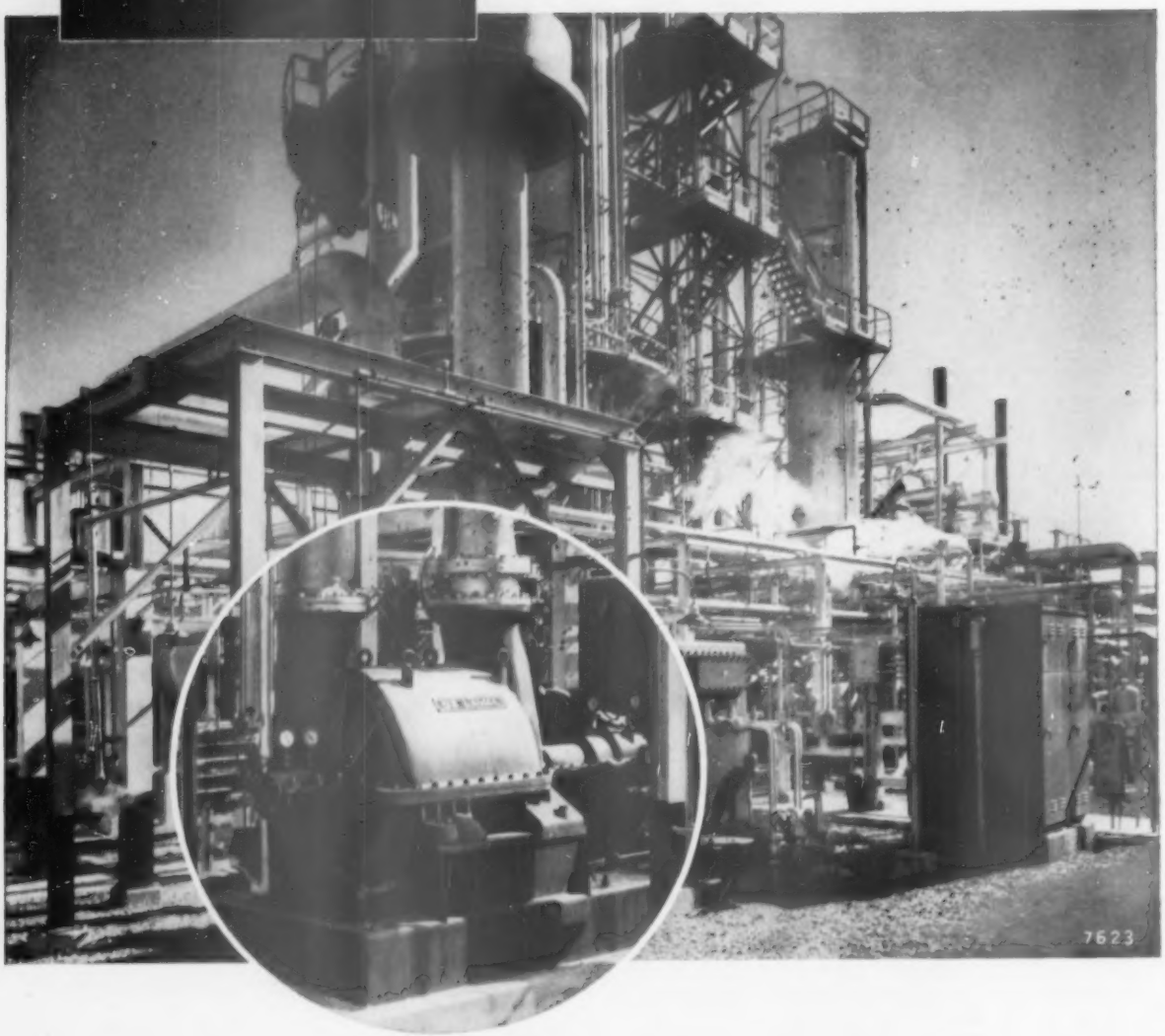
Title.....

Company.....

City..... Zone.... State.....

DE LAVAL CENTRIFUGAL BLOWER

delivers 17,400 cfm for Elreco's new cat



This De Laval Centrifugal Blower, on stream at the El Dorado Refining Company's new cat cracker at El Dorado, Kansas, supplies 17,400 cubic feet of air per minute for regeneration of the spent catalyst.

This plant, built in record time of ten months by The Refinery Engineering Company, is designed for a charge capacity of 4,300 barrels per day at 75% conversion. Elreco is another of many refineries which have chosen De Laval for dependable blower performance under heavy-duty, continuous operation. Rugged castings, husky, perfectly balanced rotor and externally mounted, cylindrically seated bearings are design features that reduce maintenance and insure long service. Send for Bulletin 0500 containing complete data.

DE LAVAL *Centrifugal Blowers*

DE LAVAL STEAM TURBINE COMPANY

810 Nottingham Way, Trenton 2, New Jersey

DL-207

PROCESS EQUIPMENT NEWS

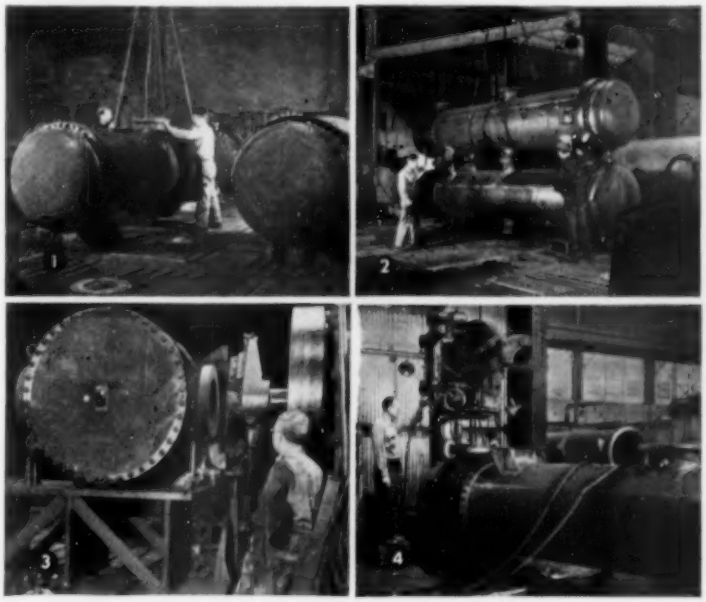
PUBLISHED BY FABRICATED PRODUCTS DIVISION, THE M. W. KELLOGG COMPANY AUGUST-SEPTEMBER 1954

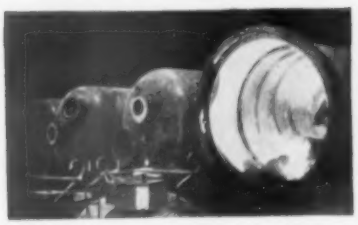
Five Giant Reactors For High Octane Gasoline Plant

In this impressive line-up in Kellogg's Jersey City, N. J., shops (below) are shown four of five identical pressure vessels currently being fabricated for a large Midwestern refiner of petroleum.

When completed, these giants will function as the reactors for a fixed bed catalytic reforming unit—a process that reforms low grade naphthas into high octane gasoline through the use of a platinum catalyst and high temperatures and pressures.

Each of the reactors is 9 feet in internal diameter by 10 feet





3 inches in length. To withstand internal operating conditions of more than 1000°F. and nearly 400 pounds pressure, they are constructed of carbon moly steel, 1-7/16 inches in thickness. When completed, each vessel will tip the scales at 39,000 pounds.

For further information, details of methods, etc. contact
FABRICATED PRODUCTS DIVISION
THE
M. W. KELLOGG
COMPANY
225 Broadway, New York 7, N. Y.
also Jersey City, Birmingham, Buffalo, Chicago, Los Angeles, Tulsa, Houston
In Canada—Toronto and Edmonton
In Europe—London and Paris
KELLOGG PULLMAN

Extra Care in Stacking Exchangers Pays Off in Trouble-Free Operation

When an exchanger consists of two or more sections, with shell and tube fluids flowing in series, it is frequently possible to save space, piping, and supporting steel by stacking the units nozzle-to-nozzle. Kellogg, in the course of its 30 years experience in manufacturing exchanger equipment, has developed a number of special techniques for stacking units whenever this arrangement is called for which assure precise alignment of nozzles, easy assembly, and trouble-free operation.

The photographs above show a sequence in just one of the precautionary operations Kellogg uses to assure proper alignment of nozzles in two vertically stacked units. Normal manufacturing and assembly tolerances for nozzle locations, height of nozzles, and angular alignment have of course been taken into consideration in these sections.

At the start of the operation, both units have been inspected and tested hydraulically. With the shell and channel nozzles of one section left unmachined and undrilled, the two units are stacked in the shop (Photos 1 and 2). In this position, the top unit is leveled, supports are shimmed as required, and the nozzles are laid out for facing and drilling to match the nozzles of the lower one which were faced and drilled prior to welding into the unit.

After determining the alignment, machining requirements, and placement of flange holes on the unfinished section, it is taken down and set up in a boring mill (Photo 3) where the nozzle flanges are faced. In the final operation (Photo 4), flanges are drilled according to the layout determined while the units were stacked.

By following this careful procedure in the shop, Kellogg can assure perfect matching of the units when they reach the field. Final assembly is thus made easier, and chances of leaks, once the stacked exchangers are in operation, are reduced to a minimum.

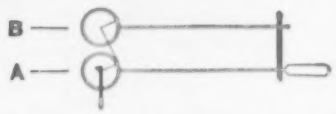
Keep "Weather-Loss"* out of your gas metering

Here's why Foxboro Anti-Ambi Recorders are more accurate . . .

*Weather-loss is the error in metered gas volume caused by temperature variations. Unless corrected, a variation of 10° F. in gas temperature will cause an error of 1% in metered volume. And that can mean big money losses from season to season. With Foxboro Anti-Ambi Temperature Recorders in your line you eliminate these errors . . . you can compute *actual* gas delivery, regardless of weather conditions.

Like all other Foxboro Instruments, Anti-Ambi Recorders are ruggedly built for accurate, trouble-free performance year after year. Weather-tight case allows outdoor installation. Write for complete information.

The Foxboro Company,
609 Neponset Ave.,
Foxboro, Mass., U.S.A.



This diagram shows the Foxboro automatic compensation for ambient temperatures. Measuring and compensating elements are located in the same case, and capillaries for both systems are in the same protective tubing. Compensating system (B) continuously corrects the primary measuring system (A) for ambient temperature changes.

Here's the small-diameter, quick-response bulb used with the Foxboro Anti-Ambi Thermometer. Bulb is made with a stainless steel neck to reduce conduction effects.

The bulb is generally protected by the special socket shown above. It has aluminum fins for rapid heat transfer, and a stainless steel extension to minimize heat conduction to the socket head.

FOXBORO REG. U. S. PAT. OFF.

Anti-Ambi THERMOMETERS

FACTORIES IN THE UNITED STATES, CANADA AND ENGLAND

And Now...

RCA Announces the FIRST Low-Cost

Packaged Microwave

with Voice Channels

PROVED throughout the nation and the world, RCA 960 megacycle Microwave is now available in a low-cost "package" unit, MM-9, as a complete station.

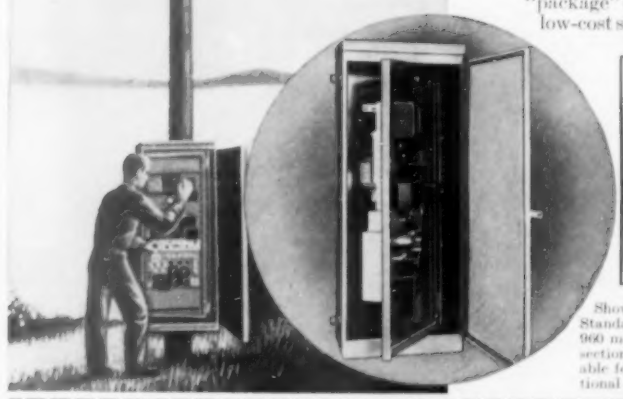
Important savings include:

- **Minimum real estate requirements**
- **No tower construction**
- **Easy economical installation**
- **Minimum maintenance**
- **Unattended reliable operation**

When mounted on inexpensive supports, such as wooden poles, up to 100 feet high, or on existing structures, which can be spaced 20 or more miles apart, the MM-9 Microwave "package" units provide an ideal low-cost solution to many point-to-point communications problems.

RCA Microwave uses highly directional radio signals which are beamed from one relay station to the next by "dish" antennas. It can be interconnected with existing telephone lines and switchboards and virtually eliminates the weather hazards of carrier and wire lines. RCA Microwave employs readily available tubes and familiar circuits which are easy to service. The RCA Service Company provides nation-wide installation and service facilities, if desired.

For complete information on the new MM-9 Packaged Microwave Stations, send coupon, below.



Showing hinged rack construction, with all components easily accessible for servicing. Standard "package" equipment includes weather-proof cabinet, 2 parabolic reflectors, 960 megacycle transmitter unit, exciter unit, 960 megacycle receiver. Also 2 100-ft. sections of semi-flexible transmission lines with all required fittings. Space is available for multiplex equipment to provide two voice channels with signaling. Additional multiplex equipment can be mounted in a similar cabinet.

Typical Uses of MM-9 Packaged Microwave:

1. Telephone Circuits
2. Supervisory Control
3. Remote VHF Control
4. Facsimile
5. Teletype

FOR

- Gas Utilities
- Electric Utilities
- Pipelines
- State Agencies
- Municipal Systems
- Police Departments
- Transportation Systems

RCA

RADIO CORPORATION of AMERICA

COMMUNICATIONS EQUIPMENT

CAMDEN, N. J.

Radio Corporation of America, Camden, N. J.
Dept. I-89, Building 15-1
In Canada, RCA VICTOR Company Limited, Montreal

Please send me your new booklet, "RCA Low-Cost Packaged Microwave Stations."

NAME_____ TITLE_____

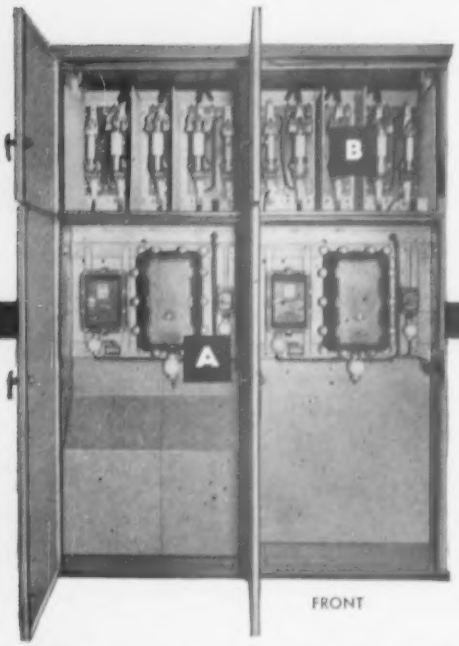
COMPANY_____

ADDRESS_____

CITY_____ ZONE_____ STATE_____

☐ *Have an RCA representative get in touch with me.*

Engineered for SAFE Operation in Semi-Hazardous Locations



FRONT

Built into every Allis-Chalmers Type H starter is the type and degree of protection dictated by applications. In these particular starters, installed in a semi-hazardous location, all arcing contacts are under oil or in explosion-proof cases.

A All overload, undervoltage, timing and auxiliary control relays, as well as other low voltage switching devices, are enclosed in NEMA VII explosion-proof cases.

B Fuse disconnects cannot be pulled when carrying current. Fuse compartment door is *key-interlocked* to the control transformer primary oil cutouts.

C Main contactor is of the oil-immersed type.

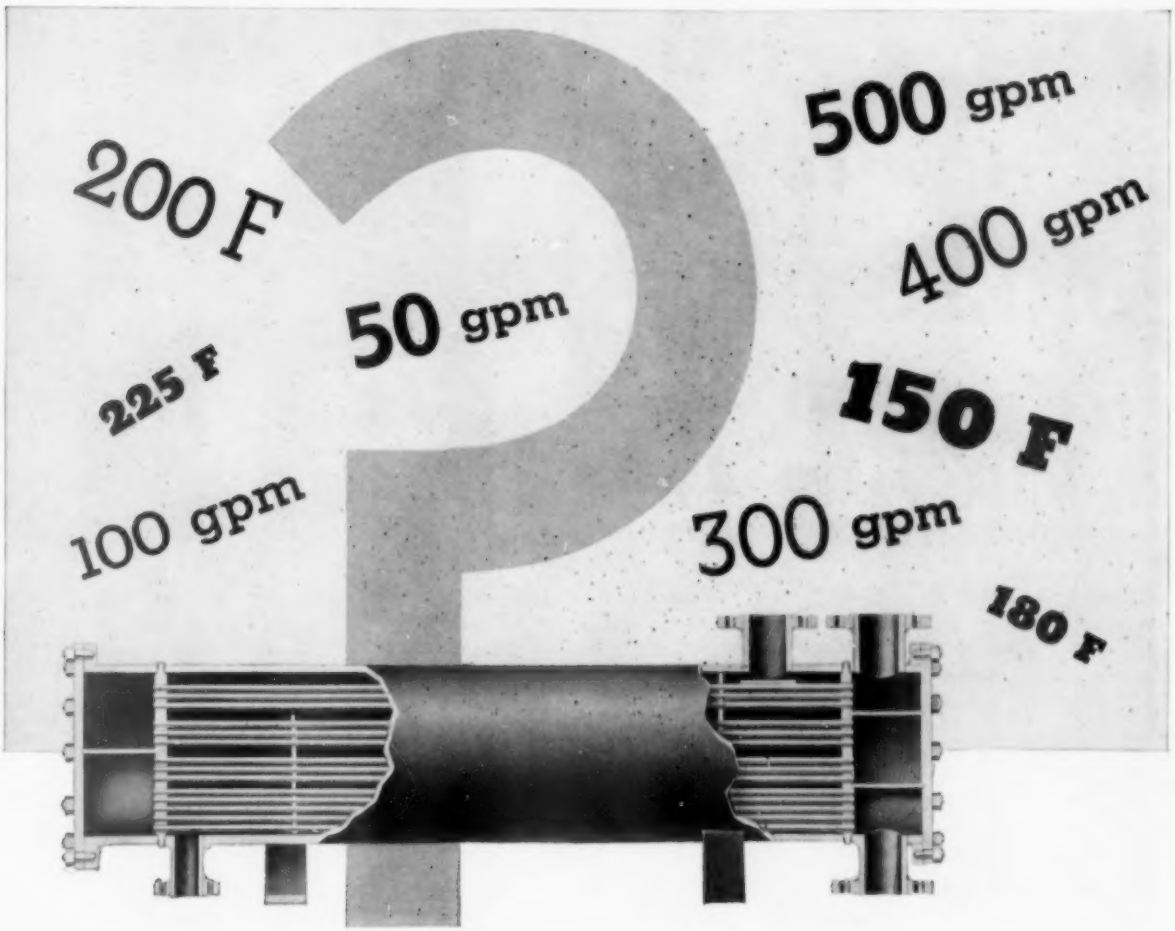
BACK

Personnel Safety
Steel barriers in the rear compartment prevent accidental contact with exposed live high voltage parts when operating the oil cutouts or removing the interlock key.

A-4446

Type H starters are built in a wide range of ratings for squirrel-cage, wound-rotor and synchronous motors — for full or reduced voltage, reversing or non-reversing — with plugging, dynamic-braking and multi-speed features. A new bulletin, 14B6410B, tells the complete story. See your nearby Allis-Chalmers representative or write Allis-Chalmers, Milwaukee 1, Wisconsin.

ALLIS-CHALMERS



How to be **SURE** of the fuel oil temperature and capacity you need

Correct fuel oil temperature and supply . . . essential to the proper operation of an oil-burning boiler . . . depend upon the fuel oil heater.

A G-R Type B Heater will heat your fuel oil instantly to the correct temperature and in the quantity required for your burner.

Besides its proved dependability, this unit has several important design advantages. Its arrangement of unbalanced passes permits lower cost because of fewer tubes in the final passes where the hot, less viscous oil can flow at higher velocity. Its readily removable covers provide easy access for tube cleaning, and its simplicity and sturdiness assure negligible maintenance expense.

To obtain all these benefits, be sure to investigate the G-R Type B unit when you need a fuel oil heater.

THE GRISCOM-RUSSELL CO., MASSILLON, OHIO

G-R HEAT TRANSFER APPARATUS **Type B Fuel Oil Heater**

GR 523

How to Get MILES AHEAD on Pipeline Jobs

From Maine to Mexico, pipeliners find that spreads move faster when the tough trench assignments are handled by Bucyrus-Erie excavators. Individual Design is one of the big reasons why. With each model in the line designed as an entirely separate model, Bucyrus-Eries are right for their work . . . have the right combination of capacity, strength, speed, and smoothness to deliver profit-making output on the toughest trenching jobs.

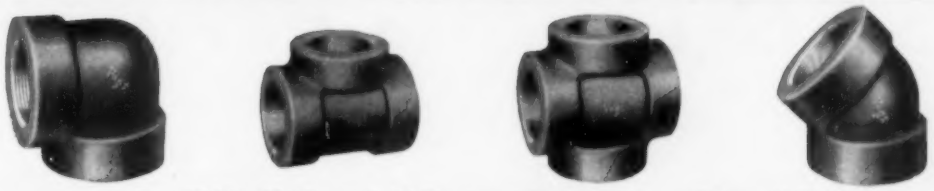
Take your digging problems to your Bucyrus-Erie excavator distributor — he'll show you how you, too, can get miles ahead with Bucyrus-Eries. 45E54

BUCYRUS ERIE

SOUTH MILWAUKEE, WISCONSIN

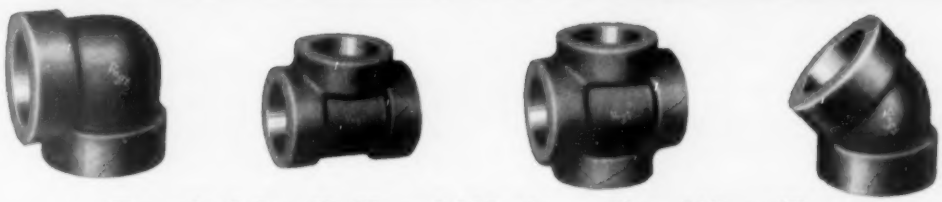
STRENGTH

for Safety and Long-Time Service



For 2000, 3000 and 6000 pounds service — Sizes 1/8" to 6"

SCREW END TYPE



For schedules 40, 80 and 160 pipe — Sizes 1/8" to 4"

SOCKET WELD TYPE

Vogt Ells, Tees, Crosses, etc., are forged from carbon steel or various alloys to meet specific operating conditions. Catalog F-9 will aid you in their selection and proper application.

Shocks and stresses imposed by high pressures and high temperatures are taken in their stride because Vogt fittings are uniform in structure, fine grained, and free from porosity . . . the superior product of laboratory controlled materials and giant forging hammers and upsetters. These properties also give higher resistance to erosive and corrosive conditions, thereby adding to service life expectancy in steam plants, petroleum refineries, chemical plants and related industries.

HENRY VOGT MACHINE CO., INC.
Louisville 10, Kentucky
BRANCH OFFICES: NEW YORK • PHILADELPHIA • CLEVELAND • CHICAGO • DALLAS

Vogt DROP FORGED STEEL FITTINGS

NATIONAL SEAMLESS USED FOR ANOTHER TOUGH JOB..

475-mile Pipeline Opens New Market Area
FOR OKLAHOMA REFINERIES

Through wooded hills . . .

across flat fields of blooming cotton . . .

and through the sandy bed of the dammed-up Arkansas River

● Approximately 34,000 tons of 12¾" O.D. National Seamless Steel Pipe were used in the construction of the 475-mile oil products pipeline for Oklahoma Mississippi River Products Line, Inc. Originating at Duncan, Oklahoma, the line runs eastward, across Oklahoma and Arkansas, to its destination at West Memphis, Arkansas. USS National Seamless Pipe was used in that section between Allen, Oklahoma and West Memphis—shown in red on the map.

The pipeline opens a large, new market area to the east for Oklahoma refineries, terminating on the west bank of the Mississippi where low cost water transportation up the Mississippi and Ohio rivers is available.

Construction of the line was started in November of 1953 and was completed in June 1954. It has an initial capacity of about 40,000 bbl. per day, operating with pump stations at Duncan, Wynnewood, and Allen, Oklahoma, and Conway, Arkansas.

As is often the case when an unusually tough job comes along—and cross-country pipelines are among the toughest—the engineers turned to National Seamless Pipe for the necessary combination of high strength, extreme flexibility, and complete uniformity that only *seamless* can give. They needed pipe that would resist great pressures, would absorb distorting and bending stresses; pipe that possessed superior welding characteristics; pipe that could be depended upon to give uninterrupted and satisfactory service for years to come. In National Seamless, they knew from long experience that they had all of these qualities, and more—the reputation and know-how of National Tube, world's largest producer of tubular steel products.

NATIONAL TUBE DIVISION, UNITED STATES STEEL CORPORATION, PITTSBURGH, PA.
COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO, PACIFIC COAST DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

WELDS WITHOUT WELDS

NATIONAL SEAMLESS PIPE AND TUBES

UNITED STATES STEEL

Gives you MORE POWER...
Gives you MORE VALUE!

Only a Dodge truck offers these exclusive years-ahead features . . . provides so much extra worth for the low price that you pay!

NOW YOU CAN GET

the world's most powerful low-tonnage truck engine . . .

NEW 145-HP. POWER-DOME V-8

for ½- through 1-ton pick-ups, panels, and stakes

☆ Greatest power line-up

Famous Power-Dome V-8's with unique dome-shaped combustion chambers for top power and efficiency! Full line of thrifty time-proved 6's, too! 6 great engines in all—103- to 172-horsepower!

☆ Easiest handling

39½ turning angle—for sharpest turning, easiest parking of any truck! Plus new gear-before-axle steering system that helps absorb road shocks, cuts driving fatigue to a minimum!

☆ Most comfortable cab

Widest, roomiest cab interior of them all—with 61¾" of hiproom, 58⅜" of shoulder-room! Deepest easy-chair seat—with 86 soft super-cushion coil springs!

☆ Best Visibility

Biggest windshield in the popular truck field—951 sq. in. in size! Most total vision area, too, with a full 2261 sq. in.! You see more from every angle in a Dodge truck!

☆ Plus biggest savings

Power-Dome V-8 design gets more miles from every gallon of regular gas, stretches your fuel dollars! And Dodge truck quality engineering saves you even more money in long life, low maintenance!

SEE YOUR DEPENDABLE DODGE TRUCK DEALER TODAY!

Added proof...

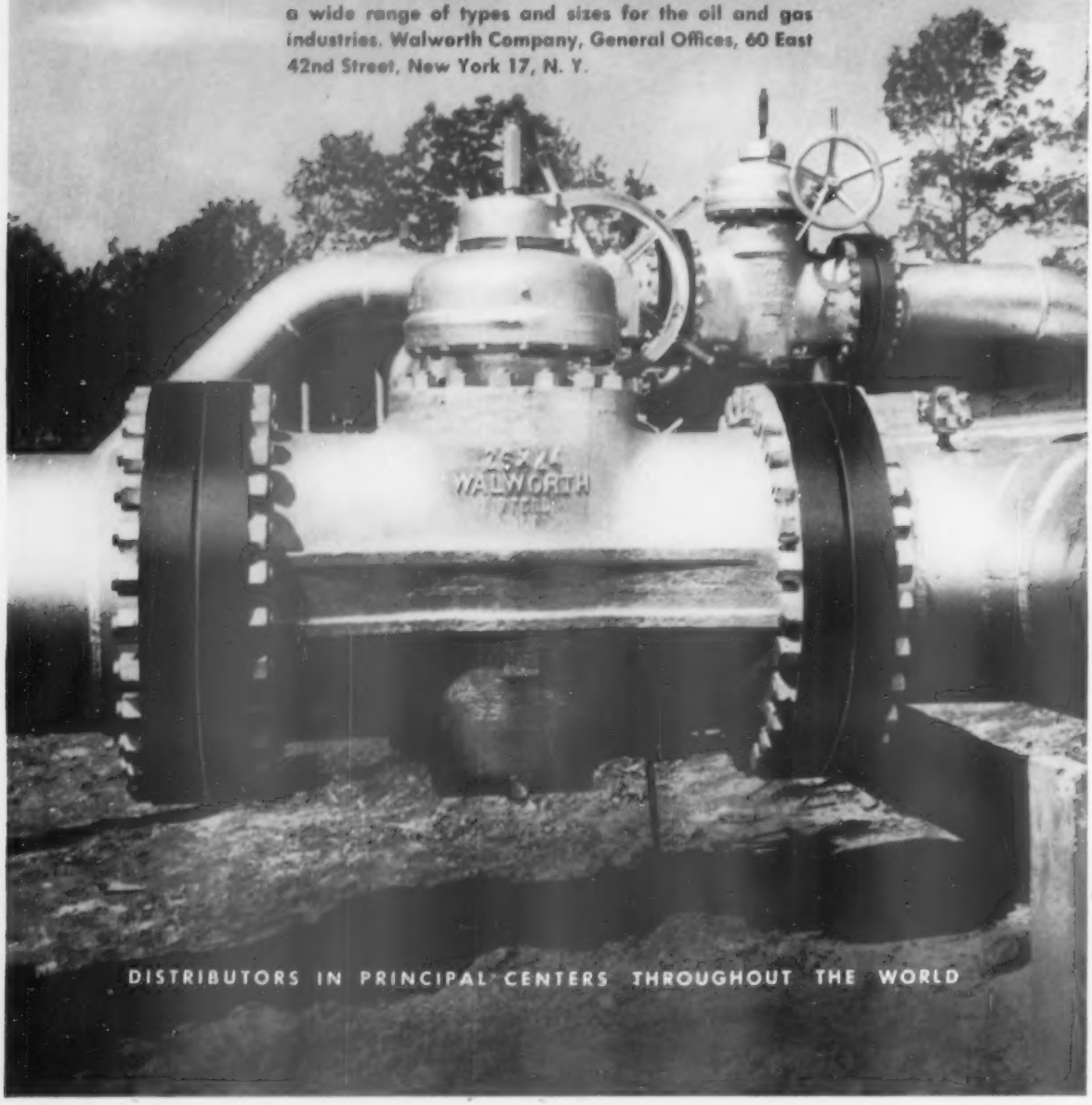
that there's a better deal for the man at the wheel . . . with new

DODGE "Job-Rated" TRUCKS

LUBRICATED PLUG VALVES by WALWORTH

Two Walworth Cast Steel Lubricated Plug Valves in use on the main line of a southeastern gas pipeline.

In addition to Lubricated Plug Valves, Walworth manufactures Gate, Globe, Angle, and Check Valves in a wide range of types and sizes for the oil and gas industries. Walworth Company, General Offices, 60 East 42nd Street, New York 17, N. Y.



DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

They Say—

Why the Industry Is Big

"... This business is big and it is growing. During 1954 it will spend ... more than four and a half billion dollars for expansion and development ... This amount is larger than the entire Canadian budget...

"What inspired this? What brought oil to such a size and what keeps it growing? The answer is free competition.

"This means that anyone and everyone has been free to enter our oil industry and to sell what he considers to be better goods or services at the same or a lower price than his competitors.

"Another way to describe freedom of competition is to call it freedom of innovation. This means that anyone and everyone has been free to enter the oil industry with any new process or product that he is willing to risk his money on in the hope of a profit...

"I am convinced that the oil industry in the United States and in Canada, or in any other country for that matter, can best serve the public when it is free from unnecessary and unwarranted government interference. That means ... freedom from onerous red tape; freedom from politically inspired attempts to replace the law of supply and demand with arbitrarily designed price structures..."

Frank M. Porter, president, American Petroleum Institute, in an address at the convention of the Association of Desk and Derrick Clubs of North America at Banff, Canada.

Migration Mistake

Dear Sir:

Thank you for the . . . congratulations on my article, "New Questions on Origin of Oil," which you printed in your August 23 issue.

I have received a number of comments on the article, which I consider a compliment to The Oil and Gas Journal as regards to its wide distribution and the thoroughness with which it is read. . . .

The last paragraph which apparently was slightly unclear to begin with was changed in the editing by the addition of a but at the beginning of the second sentence, which resulted in changing the meaning just enough that it seemed to contradict the conclusions developed in the entire preceding article.

The last paragraph was intended to

Killing FIRE Through Research

OPERATION FLAMES

Fire tests like that shown above are commonplace to the specialists directing operations at "Automatic" Sprinkler's Technical Laboratory and Fire Testing Department. Determining methods to lick fire before it gains headway, is their daily task.

These engineers design fire protection BEST-BY-TEST for severely hazardous manufacturing operations. All types of extinguishing mediums are at their disposal—every known method of fire detection is employed.

The services of this research phase of our business are available to our customers and potential customers. It's a service second to none in our field—lends credence to the motto . . . "Automatic" Sprinkler—FIRST IN FIRE PROTECTION!

"Automatic" Sprinkler
CORPORATION OF AMERICA
YOUNGSTOWN, OHIO

Offices in Principal Cities of North and South America

IMPORTANT FRACTURING

NEW SANDOIL PROPORTIONER

gives excellent, variable control...
increases success and safety of

HALLIBURTON

FORMATION FRACTURING SERVICES

Sandoil fracturing is more and more successful. And the trend is for ever-increasing amounts of material at higher rates of injection. Some formations can take higher concentrations without trouble; others are successfully treated if started low and increased gradually. Sometimes a high concentration may cause "sand out" in which the well is plugged by a non-uniform sand concentration in the fracturing mix.

First to recognize these problems, and solve them, was Halliburton . . . proving again that there's no substitute for Halliburton's experience on more than 40,000 fracturing jobs. The solution is the result of excellent, variable control of sand quantity per unit volume of oil . . . now provided by Halliburton's new Sandoil Proportioner for use with either bulk or sacked sand.

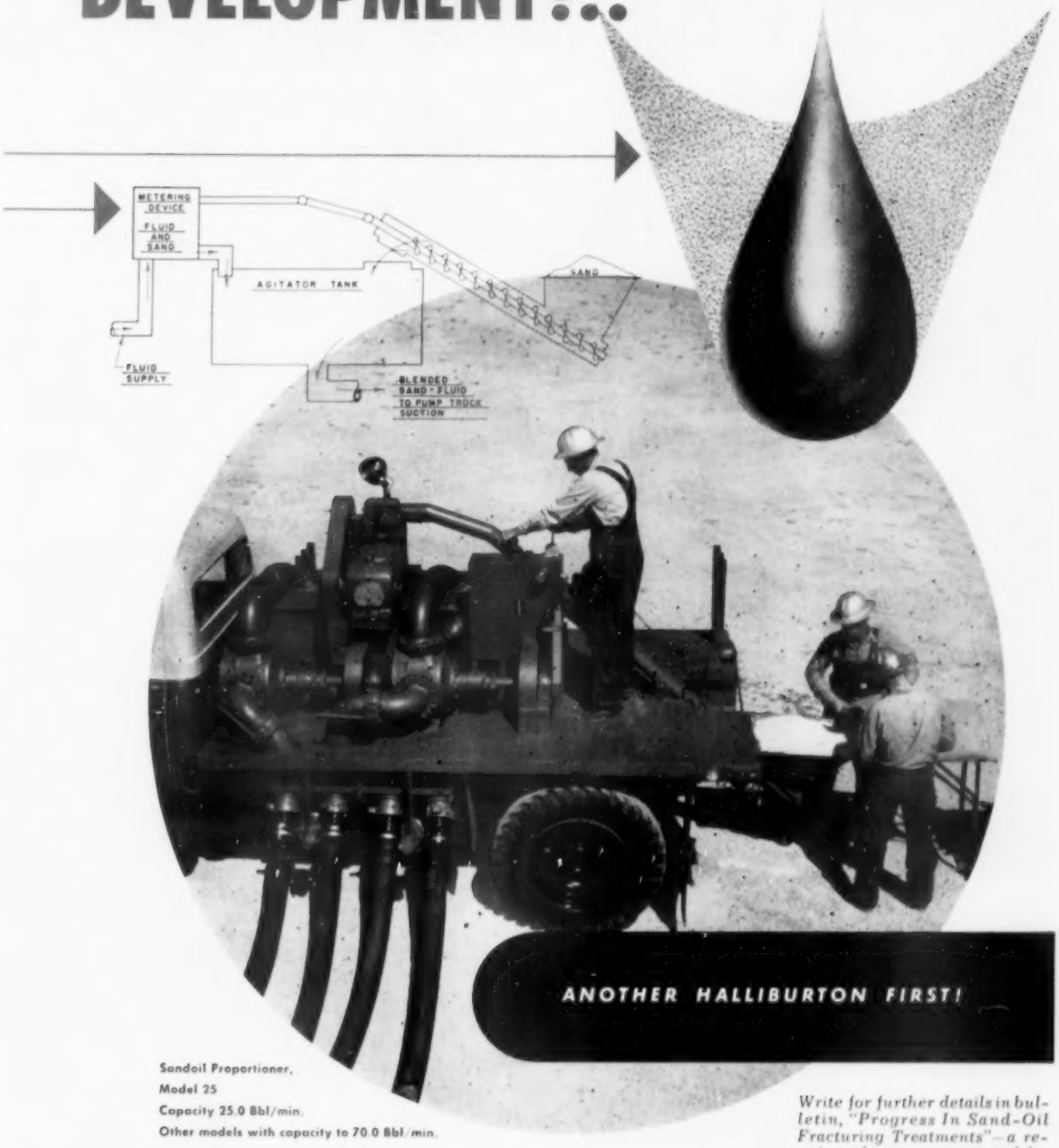
The Proportioner is a continuous means of mixing the two ingredients that allows the ratio to be varied at will by manual control and maintains accuracy within narrow limits regardless of mixing rate. It consists of (a) a mechanical agitator in the mixer tank of relatively small volume to insure high agitation and proper blending to all fluid within the mixer, (b) a proportioning screw to transport the sand into the mixer, and (c) a metering pump to supply the carrying medium.

PROPORTIONER PERFORMS THESE IMPORTANT FUNCTIONS

- ★ **Changes sand concentration over wide selected ranges at any time during fracture treatment.**
- ★ **Controls and measures sand concentration going into the well at all times.**
- ★ **Mixes large volumes.**
- ★ **Operates at high rates of injection.**

This accurate, variable control for Sandoil fracturing provided by Halliburton is an important development for greater success and safety of the big frac. Make sure your fracturing job is under control of Halliburton's Proportioner. And take advantage of the 40,000 job experience of Halliburton . . . first and foremost in formation fracturing service. Call your local or district Halliburton office. Or contact Halliburton Oil Well Cementing Company, Duncan, Oklahoma.

DEVELOPMENT!..



Sandoil Proportioner,
Model 25
Capacity 25.0 Bbl/min.
Other models with capacity to 70.0 Bbl./min.

Write for further details in bulletin, "Progress In Sand-Oil Fracturing Treatments"—a reprint of paper presented by Halliburton at API meeting, March, 1954.

HALLIBURTON

FRACTURING SERVICES

PERPETUAL PROGRESS IN PRODUCTION IMPROVEMENT TECHNIQUES

Barco Flexible STRUT* Joints

* For Structural Applications

—for Refinery TOWERS STACKS • LARGE PIPING

Barco Flexible Strut Joints are an important aid in *modern* refinery construction. A typical use is at the ends of struts for supporting or bracing large catalyst carrier lines or vent stacks on fluid catalytic crackers. In such cases, where horizontal lines require supports, two braces (with Barco Flexible Strut Joints in each) make costly "A" frames unnecessary. Other uses include the guying of tall vessels and columns and directing thermal movements of high temperature piping.

The Modern Way **to handle**

- **STRESS LOADS**
- **VIBRATION**
- **WIND SWAY**
- **THERMAL MOVEMENTS**

SIMPLE, VERSATILE!—The Barco Strut Joint is a dependable, compact, versatile fitting requiring practically no maintenance. It is a simple ball and socket that provides a point of flexibility in struts and guy rods. The close fit between the ball and the casing, allows for reversible loads, not possible with pin and clevis type braces. Barco Strut Joints support without restricting freedom of movement of piping.

COMPLETE LINE—Barco manufactures Strut Joints in the following sizes and load capacities: 1"—6,000 lbs., 1½"—8,000 lbs., 2"—12,000 lbs., 3"—20,000 lbs., 4"—50,000 lbs., 6"—130,000 lbs. Joints are made with welding ends for field or shop use. Unique "Bar-Moly" treatment of wearing parts provides a permanent dry lubrication for long service with little or no maintenance.

ENGINEERING SERVICE—Barco will be glad to work with your engineers in the selection of joints to meet your requirements. *Specifications and information on request.* BARCO MANUFACTURING CO., 539K Hough St., Barrington, Illinois.

BARCO

THE ONLY TRULY COMPLETE LINE OF FLEXIBLE BALL, SWIVEL, SWING AND REVOLVING JOINTS FOR CONVEYING FLUIDS

admit the degree of short distance migration for which there is reasonable or indisputable evidence. The limited migration accepted is far less than that which is usually used to explain commercial accumulations. . . .

D. D. Utterback,
District Geologist,
Freeport Sulphur Co.,
New Orleans, La.

Congressional Inquiry Urged

"Interior Department officials said they believed the oversupply situation was seasonal and the winter demand for heating oils would correct it. Some oil people don't seem to believe it is seasonal.

"One of the first things we have got to do is to try to get the basic facts. I believe a congressional committee inquiry would be probably the best way to get the facts.

"I believe the situation on the domestic industry front is too distressful to permit us to sit idly by, hoping that relief will come in October. . ."

Rep. Tom Steed of Oklahoma in a statement issued in Washington.

California Exploration

"In a business growing as ours is, we should be finding new oil more rapidly than we are producing the old reserves. This is becoming hard to do in California."

Robert L. Minckler, president of General Petroleum Corp.

Trinidad's Troubles

". . . Recent information published in the local press shows that some petroleum product prices have dropped by ½-cent U. S. per American gallon. . .

"Official statistics for 1953 show that Trinidad exported some 31,000,000 bbl. of petroleum products. . .

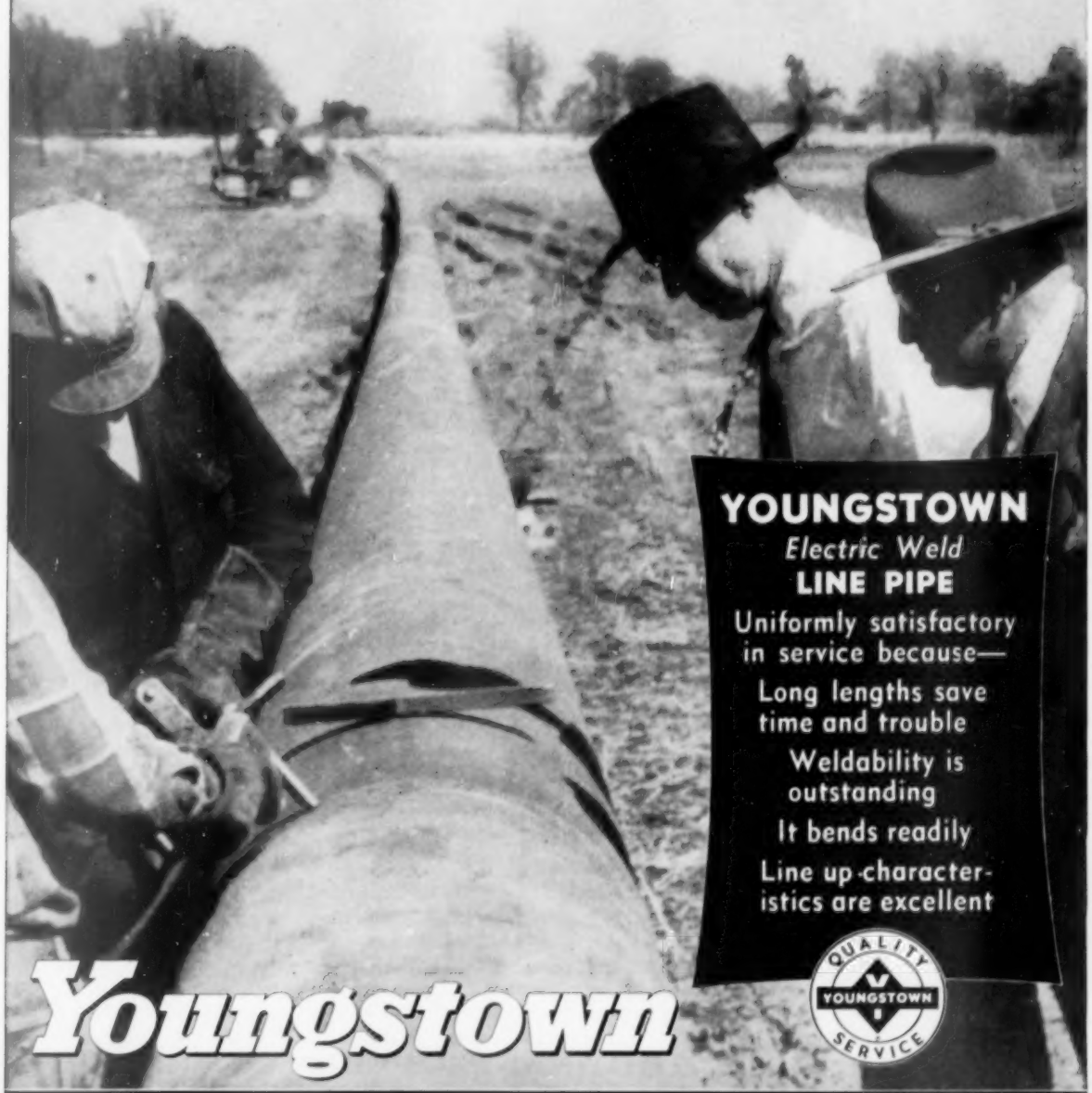
"If all oil products exported from Trinidad in a year dropped . . . ½-cent U. S. per American gallon, the loss in the value of exports from the Colony would be B.W.I. $11,000,000 at the 1953 published rate. Were such a drop applied only to products other than fuel oil, the fall in the value of exports would be B.W.I. $5,500,000. . .

". . . Trinidad . . . has been fortunate because our oil is sold at prices based on the U. S. dollar. Thus, when the pound value went down, sterling prices of crude oil and products rose correspondingly. The pound is getting stronger all the time and the possibility of free convertibility of sterling is now being discussed. When the pound rises, our oil prices will go down. These are facts we cannot ignore.

"Tougher times are ahead, but with

Yes, it's Youngstown

THE EXCELLENT WELDING QUALITIES of Youngstown line pipe are evident on every job. Pipe line contractors who are becoming increasingly critical of pipe features which add to their costs welcome this easy-to-weld pipe.



YOUNGSTOWN
Electric Weld
LINE PIPE
Uniformly satisfactory in service because—
Long lengths save time and trouble
Weldability is outstanding
It bends readily
Line up characteristics are excellent

QUALITY YOUNGSTOWN SERVICE

Youngstown

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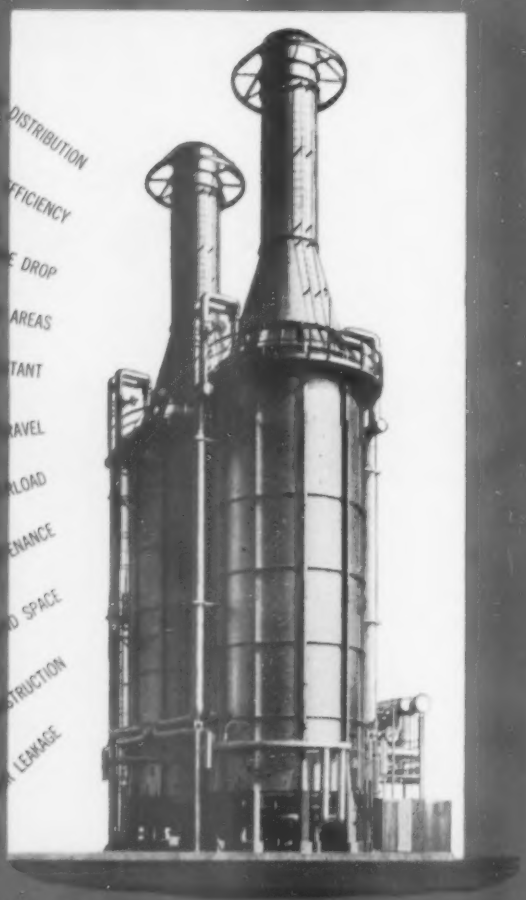
If yours is a fluid heating problem



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are most efficient by any comparison

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More than 1200 PETROCHEM-ISOFLOW FURNACES are in operation throughout the world in the petroleum, chemical and allied industries . . . for all processes and for any duty, pressure, temperature and efficiency . . . and all Petrochem-Isoflow Furnaces are pre-eminently satisfactory.

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all of us pulling together . . . we can weather the vagaries of weakening prices and strengthening sterling that lie ahead. . . "

Editorial in the June issue of Regent News, quarterly magazine of Trinidad Leaseholds, Ltd., Pointe-a-Pierre, Trinidad, B.W.I.

The Great Fallacy

"The effect of the decision (in the Phillips case) . . . and the subsequent orders of the Federal Power Commission is a further strangle hold on private industry and upon the rights of the individual states.

"The Supreme Court . . . has continued the slow but decisive move toward a strong bureaucratic central Government under the guise of protecting the consuming public 'against exploitation at the hands of natural-gas companies.' A greater fallacy has never been stated. . . "

Gov. Edward F. Arn of Kansas in an address at the Omaha meeting of the Interstate Oil Compact Commission.

GSA Can't 'Buy American'

"Essentially this is a controversy between the Independent Petroleum Association of America and the National Oil Jobbers Council. The former contend there is sufficient domestic oil products for government needs. The Jobbers Council, who claim to represent 12,000 of the 15,000 independent oil jobbers throughout the county, claim that if we do not waive the Buy American Act they will be forced out of government business.

"General Services Administration has been advised by the Oil Jobbers that: 'No jobber would be in a position to submit an affidavit that the product which he offered to sell the Government was not made from foreign crude oil or from foreign crude oil comingled with domestic oil.'

"We have the coopeartion of the Department of Interior in developing facts to help us make a decision. . .

"Our eastern and west coast regions report that they would find it difficult to produce petroleum products for their needs if the Buy American Act is not waived. Our midwestern regions find that they can probably make local procurements uder the Buy American Act, but not on a national scale. GSA makes nationwide contracts with service stations to provide government agencies with necessary petroleum products.

"The problem which we must resolve is whether . . . we can be assured of adequate domestic supplies of 100 per cent domestic petroleum products.

"We have been concerned with this

Safeguard costly overhaul jobs...use

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wherever bolt tension is specified!

Photograph used through the courtesy of H. O. Penn Machinery Company, Inc.

● Inaccurate bolt tensioning means mechanical distortion—excessive wear of critical parts—and frequently, outright failure. *Snap-on Torqometers guard against costly come-backs!* For hairline accuracy, readings on the big dial are amplified nearly 500 times. The mechanic *sees* the applied torque hit the exact pressure specified by the manufacturer. He works confidently and swiftly. Readings are *always* dependable. Torqometer design eliminates friction drag. Accuracy is never affected by the way the tool is held.

Snap-on Torqometers are built in 15 standard models, capacity from 0 to 30-inch pounds, up to 2,000 foot-pounds. (Up to 4,000 foot-pounds on special order.) Direct service from Snap-on factory branch warehouses in 43 industrial centers. Write for Snap-on Industrial Catalog and general catalog of 4000 Snap-on hand and bench tools today.

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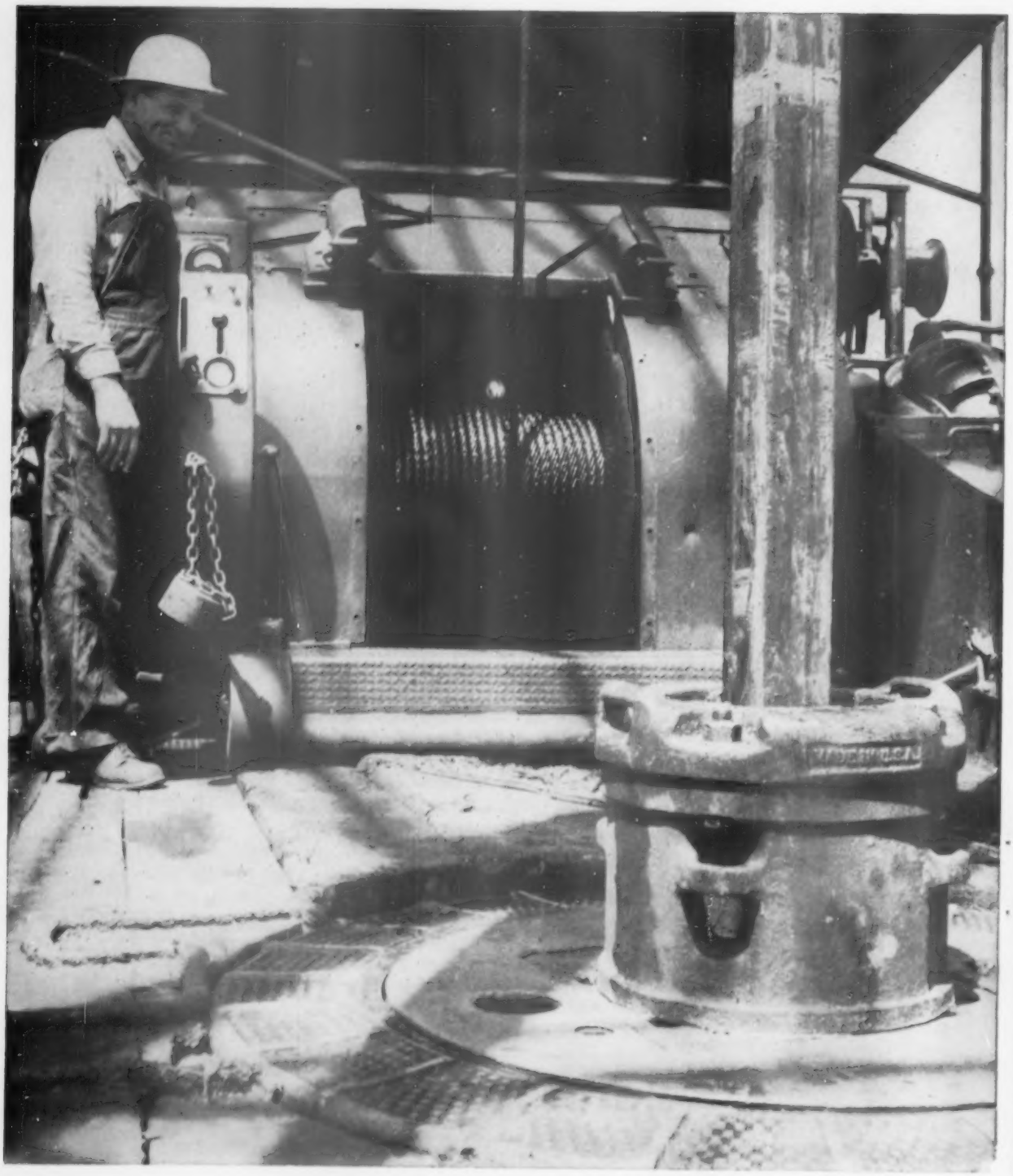
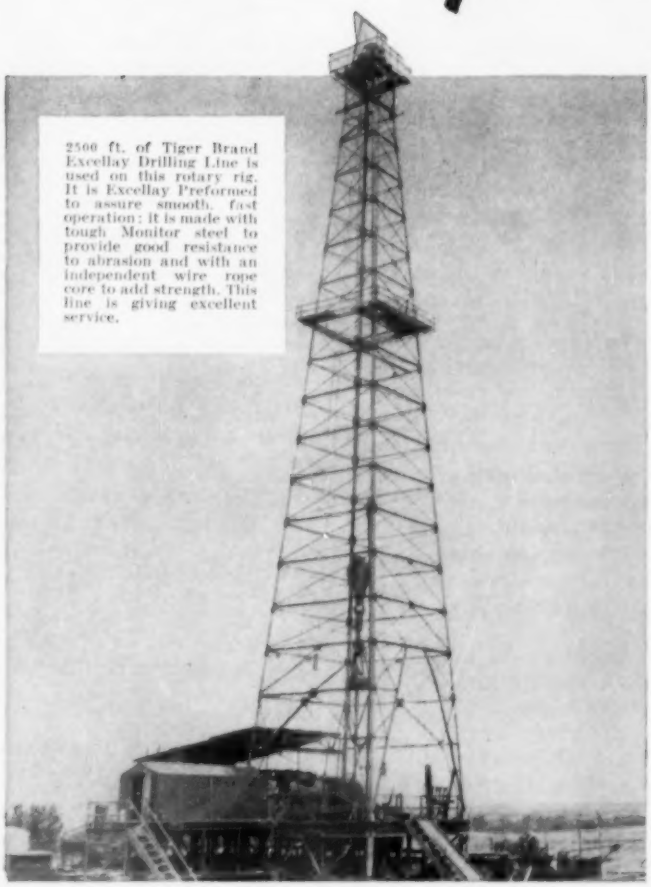
For long service



Oklahoma driller chooses Tiger Brand *Excellay* Wire Line



2500 ft. of Tiger Brand Excellay Drilling Line is used on this rotary rig. It is Excellay Preformed to assure smooth, fast operation; it is made with tough Monitor steel to provide good resistance to abrasion and with an independent wire rope core to add strength. This line is giving excellent service.

THIS rotary rig, owned by Beacon Drilling Co. of Tulsa, is working at about 8,000 ft. in the Panther Creek Field near Paul's Valley, Oklahoma. In order to be sure of getting a long-lasting drilling line that would keep line costs low, Beacon used a 1⅛" Tiger Brand *Excellay* Preformed Rotary Drilling Line with independent wire rope core.

Excellay preforming preshapes the strands to the helix they will be required to assume in the finished rope. As a result, Tiger Brand *Excellay* Line withstands bending much better than an ordinary wire rope. It has greater fatigue resistance and gives more ton miles of service before it must be replaced.

What's more, Tiger Brand Excellay Line is less likely to kink or twist than a non-preformed line; it is less lively; it can be spooled faster.

If you want these advantages in *your* drilling lines, specify Tiger Brand *Excellay*. This type of line also gives superior performance in coring lines, casing lines, winch lines, and rod and tubing lines. Your American Wire Line Distributor has complete information.

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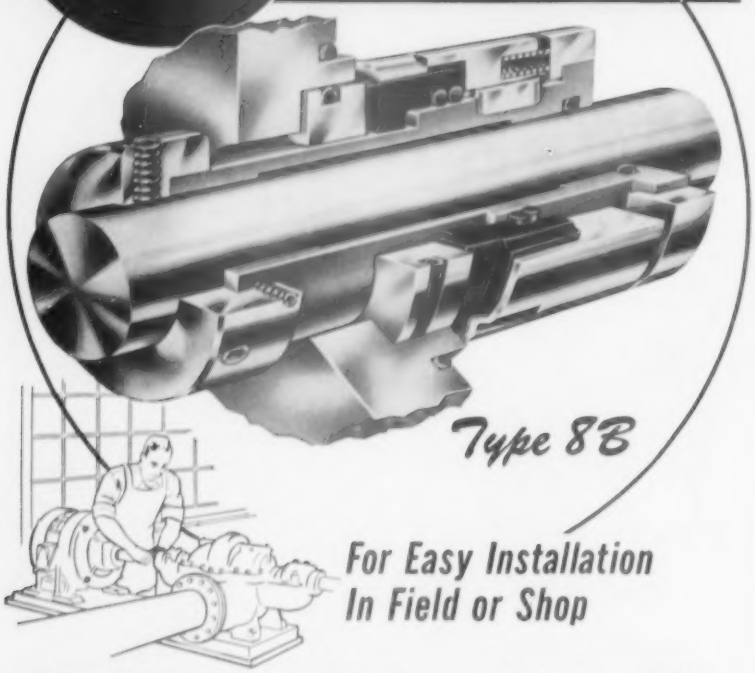
JOHN CRANE

PACKAGED TYPE MECHANICAL SEALS FOR High Pressure Pipe Line Pumps



For Easy Installation In Field or Shop

Manufacturers of large centrifugal pumps and pipe line operating engineers have long been asking for an end face mechanical seal meeting these requirements: 1) heavy-duty design to handle high pressure applications; 2) single-unit packaged construction for easy installation; 3) a full range of sizes to meet individual specifications.

"John Crane" has met this need with the Type 8B hydraulically balanced seals for pressures to 1200 psi.

These seals can be quickly installed and adjusted simply by sliding the entire unit along the shaft into final position. Removal of the top casing is not necessary. This feature alone results in the saving of many man-hours of maintenance work.

Field reports and performance records point to the steadily increasing use of "John Crane" high pressure seals to eliminate problems connected with the handling of hydrocarbons, crudes, gasoline and other petroleum products.

To help you in your individual requirements, "John Crane" offers nationwide service—available without obligation from strategically located factory owned branch offices.

Write for illustrated high pressure seal bulletin.

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JOHN CRANE CRANE PACKING COMPANY

problem for some time and hope to arrive at a satisfactory solution in the near future."

Edmund F. Mansure, GSA administrator, in a statement issued in reply to criticism of the agency's Dallas office waiving the Buy American Act in connection with petroleum purchases for government use.

CALENDAR OF EVENTS

SEPTEMBER

23-24 Western Petroleum Refiners Association, regional meeting, Henning Hotel, Casper, Wyo.

27-28 Symposium on Methods for Testing Liquefied Petroleum Gases (ASTM D-2; ASTM D-3, CNGA & NGAA), Statler Hotel, St. Louis.

27-29 Electrical Conference for Petroleum Industry, American Institute of Electrical Engineers, Mayo Hotel, Tulsa.

26-29 Ninth Annual Petroleum Mechanical Engineering Conference, petroleum division of the American Society of Mechanical Engineers, Statler Hotel, Los Angeles.

30 Southern Gas Assoication, conference on transmission management, Shamrock Hotel, Houston.

OCTOBER

1 Southern Gas Association, conference on gas pipeline rights-of-way, Rice Hotel, Houston.

1-2 Standards Engineers Society, annual meeting, Haddon Hall, Atlantic City, N. J.

3-7 ASTM Committee D-2 on Petroleum Products and Lubricants, Sheraton Park Hotel, Washington, D. C.

4-6 Petroleum Electric Power Association, twenty-sixth anniversary meeting, Jung Hotel, New Orleans.

4-6 Air Pollution Control Association, semi-annual technical conference, Biltmore Hotel, Los Angeles.

5-6 Texas Mid-Continent Oil & Gas Association, annual meeting, Plaza Hotel, San Antonio.

5-7 American Institute of Electrical Engineers, Middle Eastern district, Abraham Lincoln Hotel, Reading, Pa.

6-8 Eighteenth Technical Conference on Petroleum Production, Pennsylvania State University, State College, Pa.

7-8 California Natural Gasoline Association, twenty-ninth annual fall meeting, Ambassador Hotel, Los Angeles.

7-8 American Institute of Mining and Metallurgical Engineers, Pacific Petroleum chapter, fall meeting, Biltmore Hotel, Los Angeles.

8-9 Gas Measurement Institute, Legion Hall, Liberal, Kans.

10-13 American Association of Oilwell Drilling Contractors, fourteenth annual meeting, Biltmore Hotel, Los Angeles.

10-16 Oil Progress Week.

11-13 American Gas Association, annual convention, Atlantic City, N. J.

12-15 American Chemical Society, national meeting, Chicago Coliseum, Chicago.

12-15 Eighth National Chemical Exposition, Chicago Coliseum, Chicago.

14-15 National Association of Corrosion Engineers, South Central Region, Dallas.

14-17 Permian Basin Oil Show, Odessa, Tex.
17-20 American Institute of Mining and Metallurgical Engineers, petroleum division, fall meeting, Plaza Hotel, San Antonio.
18-19 Joint Lubrication Conference, American Society of Mechanical Engineers and American Society of Lubrication Engineers, Lord Baltimore Hotel, Baltimore.
21-22 Western Petroleum Refiners Association, regional meeting, Garrett Hotel, El Dorado, Ark.
21-23 Rocky Mountain Oil and Gas Association, annual meeting, Cosmopolitan Hotel, Denver.
22-24 Golden Trend Oil Exposition, County Fairs Building, Pauls Valley, Okla.
24-26 Independent Petroleum Association of America, annual membership meeting, Mayo Hotel, Tulsa.
25-27 Diesel and Gas Engine Power Plant Operators Conference, sixth annual conference, Oklahoma A. & M. College, Stillwater, Okla.
25-27 National Lubricating Grease Institute, annual meeting, Mark Hopkins Hotel, San Francisco.
26-28 Society of Automotive Engineers, national diesel engine meeting, Statler Hotel, Cleveland.
29 Natural Gasoline Association of America, southern regional meeting, Blackstone Hotel, Tyler, Tex.

NOVEMBER

1-3 Geological Society of America, annual meeting, Statler Hotel, Los Angeles.
3-5 Gulf Coast Association of Geological Societies, fourth annual meeting, Rice Hotel, Houston.
4 American Association of Oilwell Drilling Contractors, third annual South Louisiana safety clinic, New Iberia, La.
4-5 Society of Automotive Engineers, national fuels and lubricants meeting Mayo Hotel, Tulsa.
5 Southern Gas Association, conference on field production of natural gas, Herring Hotel, Amarillo.
8-11 American Petroleum Institute, thirty-fourth annual meeting, Conrad Hilton Hotel and Palmer House, Chicago.
11-12 American Association of Petroleum Geologists, Pacific section annual meeting, Biltmore Hotel, Los Angeles.
17-18 North Texas Section, American Institute of Mining and Metallurgical Engineers, and Production Committee of the North Texas Oil and Gas Association, symposium on secondary recovery, Wichita Falls, Tex.
18-19 National Association of Corrosion Engineers, fourth annual conference of western region, Hotel Biltmore, Los Angeles.
18-19 Society of Exploration Geophysicists, eighth annual midwestern meeting, Adolphus Hotel, Dallas.
~~28-Dec.~~
3 American Society of Mechanical Engineers, Statler Hotel, New York

DECEMBER

2-4 Interstate Oil Compact Commission winter meeting, Drake Hotel, Chicago
2-4 American Chemical Society, Southwest Regional meeting, Fort Worth, Tex.
3 Natural Gasoline Association of America, Panhandle-Plains regional meeting, Herring Hotel, Amarillo, Tex.
12-15 American Institute of Chemical Engineers, annual meeting, Statler Hotel, New York.

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You'll find it easy to fit your lines with YALE Blank Cap Unions. Immediate delivery begins on all sizes from 2" through 36"; smaller or larger sizes can be furnished without undue delay.

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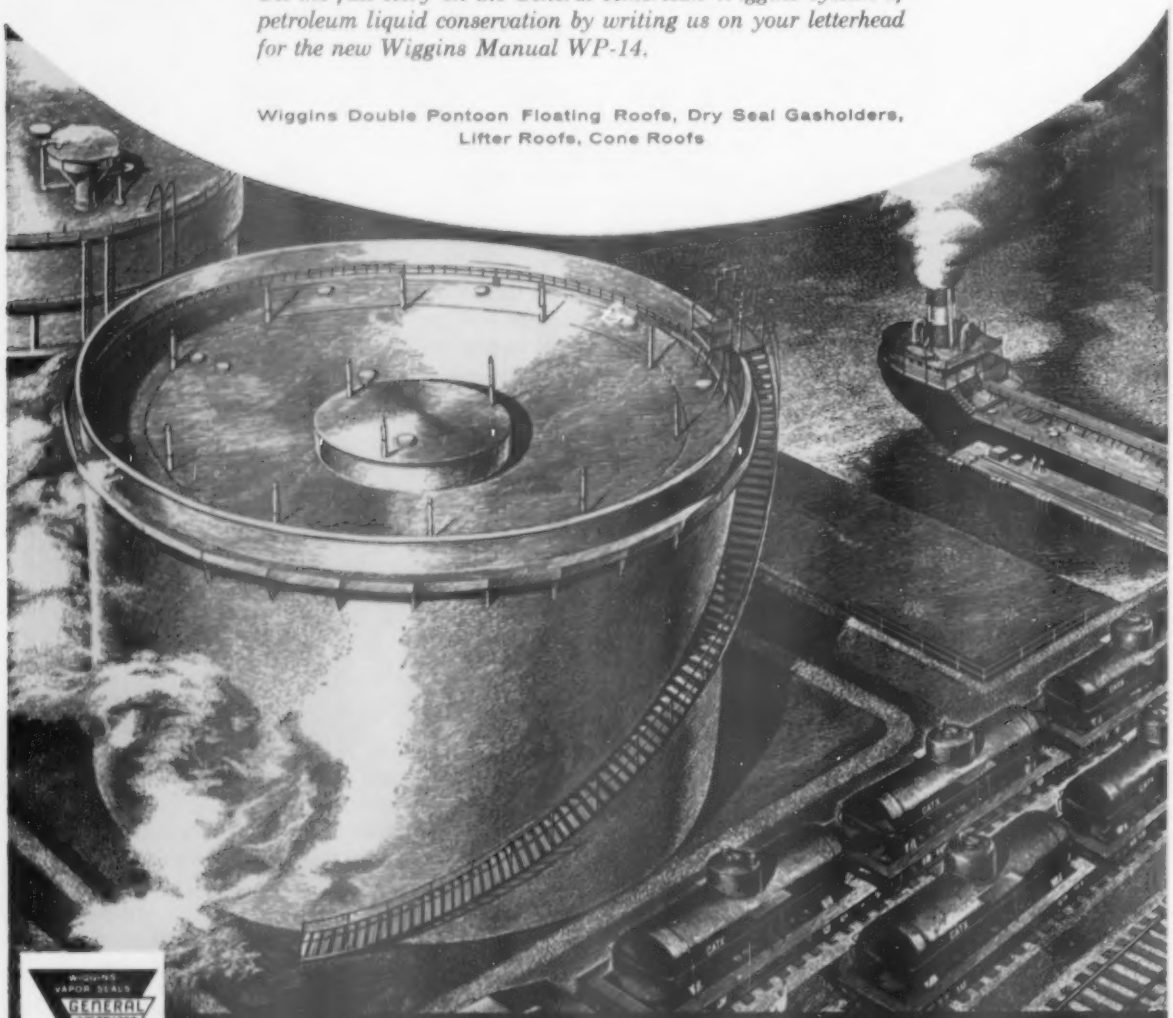

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JOURNAL
TULSA, OKLAHOMA

Published every Monday by The Petroleum Publishing Co., 211 S. Cheyenne, Tulsa, Oklahoma. Phone 3-6291. Founded in 1902. Name changed to The Oil and Gas Journal in 1910 by Patrick C. Boyle.

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JOURNALLY Speaking

Underground Movement

WE hope Senator McCarthy won't investigate us, but this issue of our favorite oil publication is devoted to an underground movement—oil and gas pipelining. It's really not a subversive movement, though at various times in its history it was fought as such by teamsters, railroads, and coal interests who feared it would undermine the basic foundations of their way of life.

Anyone who still has the naive idea that pipelining consists simply of burying a few lengths of pipe in the ground ought to get a mouthful of some of the technical articles in this issue. He'll soon conclude that pipelining has quite a few problems peculiar to itself and is using all branches of science to lick them.

For instance, take the lead article and its accompanying charts on the gas-flow analyzer. Now there's a little mathematical gem. One quick glance was enough to convince us that it probably ranks right along with Einstein's calculations which proved that the A-bomb would work. But for pipeliners it's just the sort of thing they need, and with it they can solve all problems of gas flow except how to keep gas flowing into an interstate pipeline without violating either state conservation orders or the Federal Power Commission's regulations.

Look: No Hands

CALL it what you want—automation, instrumentation, remote control, push-button operation, robots, mechanical slaves, electronic age—there's certainly a strong swing toward getting away from using so many human hired hands in pipeline operation.

We don't know where this trend may stop. The ultimate, we assume, will be a system whereby electronic brains will control the output of crude at the wells in accordance with demand forecasts, automatically adjust refinery yields to make the quantities of products called for by the season of the year, and deliver through direct pipelines to each home owner's basement a metered quantity of heating oil based on degree-day calculations—and then make out and mail the bills for same.

But don't worry about this reducing the number of jobs in the oil industry. Think of all the high-priced experts it will require to design, install, and check up on such a system. If one robot should blow a vacuum tube the industry's supply-demand situation could get as badly out of balance as it is today with humans guiding it.

The Caissons Go Rolling

PIPELINE progress has been so rapid that only a rare old-timer recalls when artillery practice was standard operating procedure at oil tank farms. Magnolia Petroleum Co. uncovered the story recently when officials inquired what one of its pump stations was doing with a muzzle-loading bronze cannon of Civil War vintage.

The cannons were used to fight tank fires, and the idea was simplicity itself—shoot a hole through the side of the tank near the water line and let the blazing oil run out into the earthern fire dike to burn itself out harmlessly; otherwise the water in the tank bottom would soon start to boil—with explosive results.

But as artillerymen, most pipeliners would have made John Paul Jones and Israel Putnam turn over in their graves. Sometimes a shot sailed clear over the burning tank and punctured another one, draining it to the bottom. Even when their aim was better, the boys still had troubles. Like the times when the solid ball would go neatly through both sides of the target tank and into one beyond. And one veteran of the "tank battery" tells how, to avoid the recoil, he backed his weapon solidly against a big stump—and blew the back end out of the barrel. But modern methods of preventing and controlling fires have long since sent the caissons rolling into limbo.

—Henry D. Ralph.

At a cost comparable to conventional compressor piping - you can install a GUARANTEED Fluor Pulsation Dampener Piping System*

On new construction we can fabricate and install a complete Fluor Pulsation Dampening Piping System that prevents compressor pipe vibration, at a price almost identical with that of a normal system of conventional piping.

How can we do it? Because we've been in the pipe dampening business a long time. We pioneered the use of piping systems based on scientific acoustical principles applied to fluid flow. We've learned from experience: since 1943 we've put into service 351 Fluor dampening installations throughout the world. We know that when we install a system we can guarantee it without equivocation. In plain words, we know our business.

To save time and costs on these jobs, Fluor maintains two well-equipped pipe fabricating shops—one at Los Angeles and one at Paola, Kansas. Fluor has perfected streamlined techniques for designing and building dampening systems—has the volume production to cut manufacturing costs—possesses the necessary experience to offer a better integrated unit at a price comparable with any normal system.

In addition to getting an economical "packaged" piping system free from vibration, you get many plus advantages in a Fluor designed system: more accurate flow measurement, lower maintenance costs, greater safety to personnel and elimination of vibrational stress on heat exchangers, vessels and related equipment. If the cost of a Fluor dampening piping system is measured by these advantages, then it is certainly one of the most economical buys in compressor plant equipment, today.

Fluor has something very definite to offer you—something far superior to any substitute method of reducing pulsation in pipe. Why not call us for an estimate and find out.

For information on Fluor Pulsation Dampener Piping Systems, write for Bulletin PDS-8501-R.

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*U.S. Patents: 2,405,100—2,474,555—2,620,969

Why pipelines are intermeshed with the whole oil industry

WHERE to lay a pipeline—and when—is just as important as how to lay it, and in recent months the oil industry has seen several examples of how fast-acting competition and long-range economic planning have resulted in decisions on new crude and products lines.

Unlike a gas line, an oil pipeline is not a public utility. It has no exclusive franchise, no protection against competition, no long-range assurance of either supplies or markets. It's a risk business.

The first line into a new area gets the traffic, but if it is too early, or so costly that its rates are too high, the traffic may not develop as anticipated. And under today's fast-shifting competitive conditions, an established traffic may be whittled away and a line made obsolete either by technological improvements which cut operating costs of newer lines or by shifts in sources of supply.

THAT'S WHY IT IS SO DIFFICULT for an independent to finance or operate a truly common-carrier oil pipeline. With no important exception, every crude or products line in the country has behind it one or more oil companies directly interested in the production of much of what goes into it or the marketing of much of what comes out of it.

Years ago a practical-minded Interstate Commerce Commission observed that oil pipelines are essentially plant facilities, and so never did much about the congressional dictum that they are common carriers in law. They are still essentially plant facilities, despite a current trend toward joint ownership. Even legal divorcement from shipper interests wouldn't make them less so in fact.

Unless contracting companies are set apart as such, there is no "pipeline industry" in the oil business. Pipeline planning and operation are integral parts of the integrated oil industry—regardless of corporate structure.

THOUGH THE TECHNOLOGY of pipeline design and control of liquid movement is becoming highly specialized and intricate, the location and operation of crude and products lines are governed by the broad interplay of all the economic forces at work in the petroleum industry.

Trends in the regional development of crude sources, in refining technology, and in the quantity, quality, and geographical aspects of market growth are the important factors in successful pipelining.

A good pipeliner has to outguess geography, geology, economics, technology, psychology, and politics—and above all, what his competitors are apt to do.

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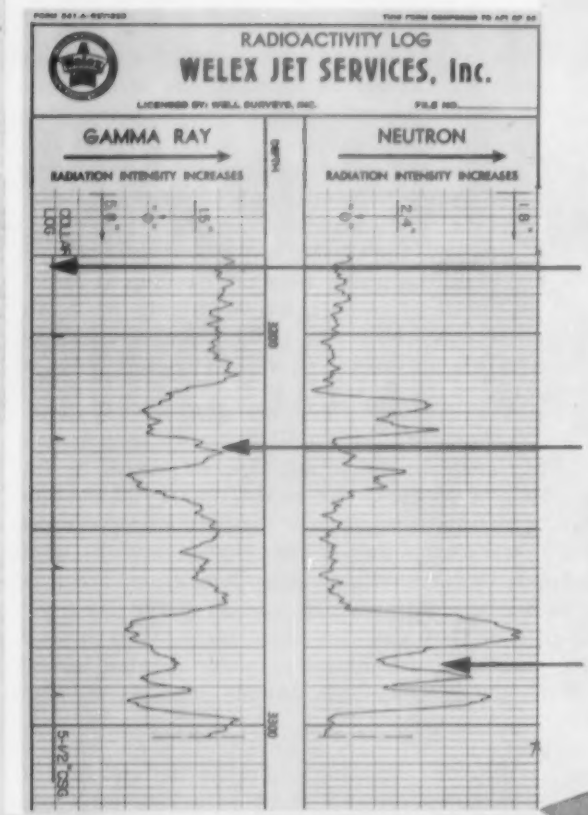

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The Gamma Ray Log gives you clear, sharp, repeatable definitions of the formations traversed in the borehole. Accurate location of the formation with the Gamma Ray Curve eliminates guess work in perforating and well completion practices.

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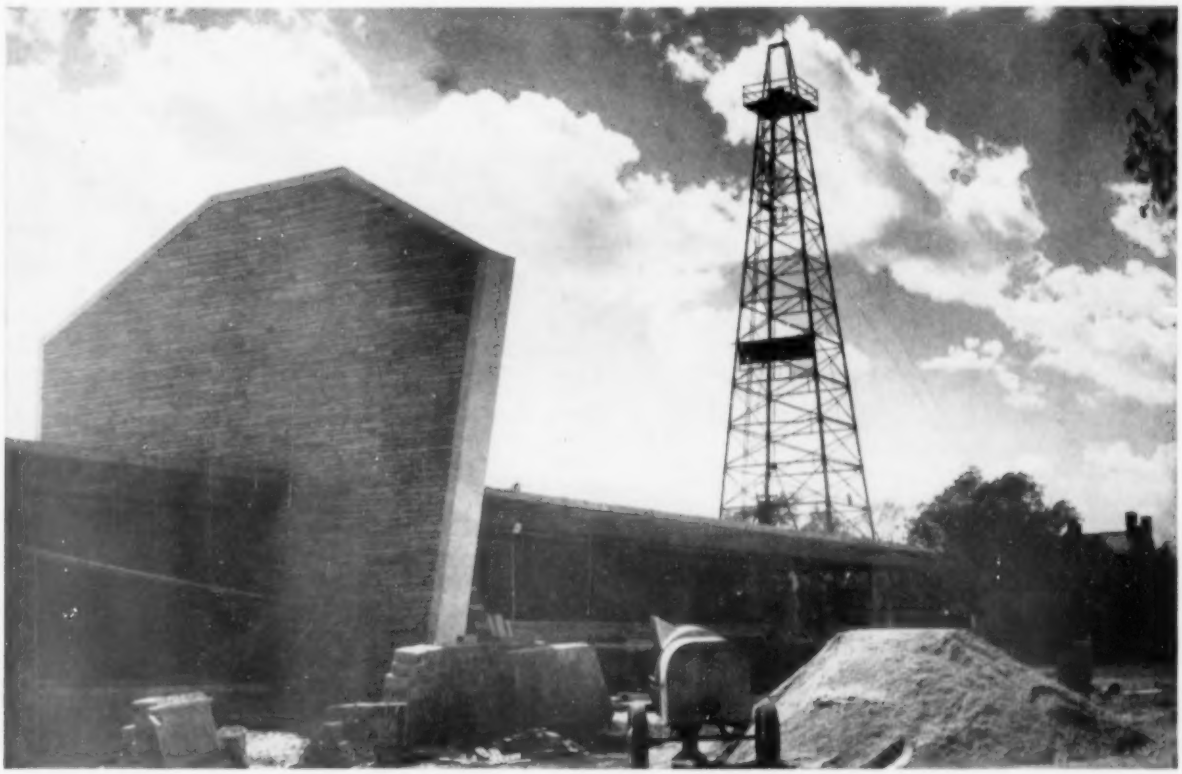
THIS WEEK... ...IN THE NEWS



AS THE INTERSTATE OIL COMPACT COMMISSION, meeting at Omaha, rolled out the welcome mat to new petroleum-producing states (see pages 132-133), workmen in Oklahoma City were nearing completion on the organization's new home. The structure will be ready for occupancy about November 1 and will provide spacious quarters, for I.O.C.C. headquarters, now housed in the State Capitol. The building is being constructed a short distance east of the governor's mansion, on land made available by the Oklahoma Legislature.

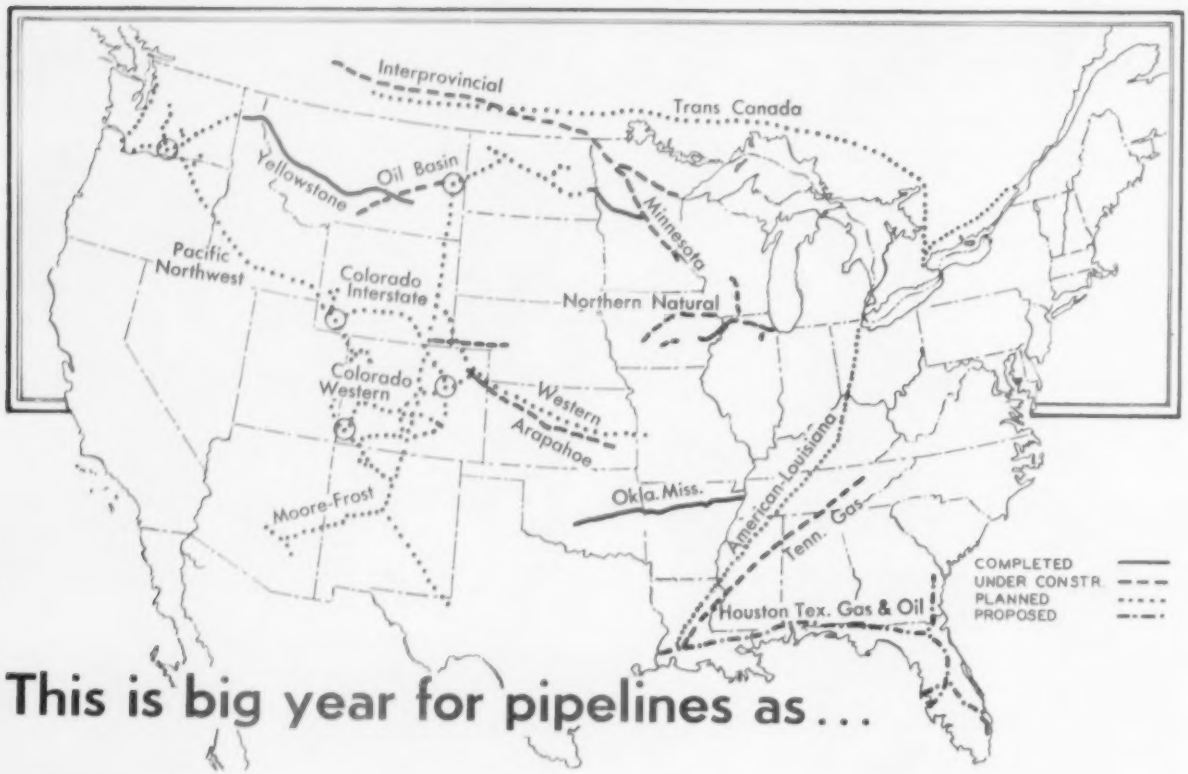
NATURAL GAS—Two organizations, the Interstate Oil Compact Commission and the Independent Natural Gas Association of America, pass resolutions urging Congress to take immediate action removing natural-gas producers and gatherers from the jurisdiction of the Federal Power Commission. . . . Resolutions pass amid general denunciation of FPC's newly assumed authority over gas producers. . . . ¶Commission members tell gas men at New Orleans meeting things could be worse without the much-criticized Order 174-A. . . . ¶Compact Commission speaker Paul Kayser predicts federal regulation of oil production will follow in footsteps of FPC jurisdiction over natural gas. . . .

PIPELINES—Uncertainty in the natural-gas industry may slow down permits for transmission lines during second half of the year, but no letup in construction is evident. . . . ¶It looks like a big year for products lines, and new production in Rocky Mountains is spurring plans for additional crude outlets there. . . . ¶Western Pipe Line Co. starts construction of big crude line from Fort Laramie, Wyo., to Freman, Mo. . . . ¶Harbor Products System goes into operation. . . . ¶Shell Pipe Line Corp. plans crude line serving Cabin Creek field in Montana. . . .

GOVERNMENT—Defense Department urges caution on import action. . . . Claims any cut might injure political and commercial relationship with countries with petroleum reserves. . . . Report says refining balance would be upset if imports eliminated. . . . ¶American Louisiana's application to build Louisiana-Michigan pipeline is stymied by natural-gas suppliers reluctance to file necessary certificates with FPC. . . . Counsel says producers will not file certificates unless they are legally required. . . . Hearings postponed indefinitely. . . . Charges against former Representative Casey of Massachusetts dismissed in case involving purchase of surplus tankers. . . . Interests headed by Newbold Morris, one-time official in the Truman administration, settle tanker lawsuits with Government. . . .

TECHNOLOGY—Chemists concentrate on new catalytic processes for improving motor fuel. . . . Experiments reported to American Chemical Society at annual meeting in New York point to higher yields per barrel of crude and better performance per gallon of gasoline. . . .

INTERNATIONAL—Floyd Odlum's proposed oil-development deal with Argentina revised. . . . Uranium and thorium survey included in latest plans. . . . Agreement trimmed from 25 to 15 years. . . . ¶Three majors continue expensive exploration in New Guinea jungles. . . . Cost since late 1930's top $110 million. . . . ¶Indian Government urged to build oil-from-coal plant despite high cost. . . .



This is big year for pipelines as...

Products, Crude, Gas Lines Grow

John M. McGivern

IN Gladewater, the center of the fabulous East Texas field, the natives say that if there were an earthquake and all the soil were shaken loose Gladewater would still be held upright by the hundreds of miles of pipe that run from the wells and tanks in the vicinity.

As the country goes into the final quarter of 1954, it begins to look as if this local joke might someday hold true for the remainder of the nation—and if the present trend continues, for Canada.

Everything points to this being the "big" year for products lines; 1,100 miles have been completed, 2,110 miles are under construction, and approximately 1,600 miles of new line are being planned. The planned total could easily be on the conservative side as it does not include the 1,425-mile line planned by American Pipe Line Co. from Beaumont to Newark.

The Federal Power Commission has authorized the building of 4,500 miles of interstate natural-gas pipeline through the first half of 1954. In 1953 interstate lines totaled 5,100 miles. The Phillips decision by the Supreme Court and the FPC's subsequent interpretation of the order will slow down permits the second half of the year, but even so 1954 should be a bigger gas year than 1953 in permits and building.

Crude lines have fallen from the rate established in 1953 *(The Oil and Gas Journal, July 26, page 182)*. Journal figures show that only 1,300 miles have been completed so far in 1954 compared to 5,200 miles in 1953. However, a recent surge in the Rocky Mountain area has boosted crude mileage now under construction or consideration to 4,200 miles.

Products . . . Practically every section of the country with the exception of the Southeast has seen activity this year in products lines. Since the hop by boat from the Gulf Coast refining area to the coast ports of Florida, Alabama, and the Carolinas is so short, pipelines might face their toughest competition there for sometime.

In the East, a small but highly important economic line, Harbor Products System, has just been completed. This 86-mile, 16-in. line connects the nation's second largest refining area, the Philadelphia area, with the nation's largest marketing area, New York City.

In the West, the 531-mile, 10-in. Yellowstone Pipe Line Co. line from Billings, Mont., to Spokane, Wash., was big news in products. The line, which recently went into operation, is the first to serve the Northwest area. Other lines now being built in the Rocky Mountain-Williston basin area are the Wyoming-Nebraska line from Cheyenne, Wyo., to North Platte, Neb., and Oil Basin Pipe Line Co. line from Billings to Glendive.

In the Midwest Great Lakes Pipe Line Co. wound up a 714-mile expansion of its system this summer, and Badger Pipe Line Co. has begun its 195-mile line from the Chicago area to Madison, Wis.

In the Far North, the U. S. Government is making good progress with its Haines to Fairbanks, Alaska, line. It will be 600 miles of 8-in. and at present the contractors expect to have all pipe in the ground by the first of November. However, it will not be ready to take products before July of next year.

In the Southwest, Texas Eastern Transmission Corp. has an application before the Federal Power Commission requesting permission to abandon the

Little Inch gas line and convert it back to products, for which it was originally built.

Vigorously opposing this request is American Pipe Line Co. American surprised the industry sometime ago by coming up with a 40 per cent Office of Defense Mobilization writeoff, but since then has made very little progress toward getting started.

Perhaps the most fascinating field open to products right now lies in liquefied petroleum gases. Statistics show that for the first 6 months of 1954, only 0.7 per cent of L.P.G. went to market by pipeline route, but two companies have plans in the mill right now to build this type of line.

In Kansas, Sunflower Pipe Line System has received permission of the Corporation Commission to build a 215-mile, 6-in. line from western Kansas to Wichita. However, the company is presently stymied by a protest filed by Warren Petroleum Corp., a large tankcar marketer of L.P.G., and Santa Fe Railroad, a large hauler of tank cars.

In Texas, H. W. Bass & Sons, Inc., is planning a 152-mile line of undetermined size to carry L.P.G. from plants in Duval and Live Oak counties to Corpus Christi.

So L.P.G., while slighted by builders of products lines in the past, seems to be in for an active last quarter 1954 and a very active 1955.

Natural gas . . . Much has been written on the Supreme Court decision in the now famous Phillips case and much has been put on paper about the Federal Power Commission's authority to act as it has following the decision. One thing certain, however, is that natural gas construction will be slower until natural gas producers find out where they stand.

Of the 4,500 miles of interstate line granted by the FPC during the first half of 1954, the largest single project was the 1,899 miles of transmission line and laterals granted to Pacific Northwest Pipeline Corp. for its system from Ignacio, Colo., to Bellingham, Wash.

Tennessee Gas Transmission Co. is working on 566 miles of 30-in. line and Northern Natural Gas Co. is winding up an expansion program of over 450 miles of all sizes of pipe. Panhandle Eastern Pipe Line Co. received a temporary certificate last week from the FPC for permission to construct 295 miles of 30-in. looping and Texas Eastern Penn-Jersey Transmission Corp. has approval of a 265-mile, 24-in. line from Oakford storage field in Pennsylvania to Lambertville, N. J.

However, with few exceptions the other large lines are being held back. American Louisiana Pipe Line Co. is still before the commission with its plans for a 1,121-mile, $130,000,000 line from Louisiana to near Detroit. Houston Texas Gas & Oil Co. has grandiose plans for gas lines from Texas to Chicago and from Louisiana to Florida. However, the company has not filed an application yet with the FPC.

The largest natural-gas line ever proposed is finding smooth sailing at present. Trans Canada Pipe Lines, Ltd., is in the process of closing financial arrangements for its 2,247-mile, 30-36-in. line from Alberta to Toronto and Montreal. A company, Alberta Gas Trunk Line, Ltd., has been formed to build the gathering system for the huge Trans Canada line and talk is that the line may be started in the spring of 1955.

Crude . . . At mid-year the pipeline picture showed that natural-gas and products lines were more in the fore than were crude lines. However, in July Arapahoe Pipe Line Co., a joint venture of Sinclair Oil & Gas Co. and Pure Oil Co., announced its 494-mile, 18-20-in. line from Merino, Colo., to Humboldt, Kans.

Shortly after Arapahoe made its announcement, one of the Standard companies made a move to bring more Rocky Mountain crude to the refining centers of the Midwest. Standard Oil Co. (Ind.) through its pipeline company, Service Pipe Line Co., formed Western Pipe Line Co. to build a 630-mile, 20-22-24-in. line from Fort Laramie, Wyo., to Freeman, Mo. The contract for the line was let around the first of September and the company said it plans to have the line in operation by December 1.

The next crude line plans revealed were by a syndicate headed by Wiley F. Moore, a veteran of the oil business and a long-time representative and marketer for Pure at Atlanta. Moore had announced earlier in the summer the letting of contracts for Oil Basin Pipe Line Co., a products line between Billings and Glendive, Mont.

Then following a meeting between Moore, Jack Frost, Dallas oil operator, and John MacArthur, chairman of the board of Bankers Life & Casualty Co. of Chicago, plans for an 1,800-mile crude line, a 130-mile products line, and two refineries were announced. *(The Oil and Gas Journal, August 23, page 96).*

The refinery sites are at Albuquerque, N. M., and Coolidge, Ariz., between Phoenix and Tucson.

To serve these two refineries with capacities totalling 35,000 bbl., the syndicate of Moore, Frost, and MacArthur plans to build two separate lines.

The first portion of one line will originate near Glendive and go to Guernsey, Wyo., and will be built by Standard Pipe Line Co. The last portion of this line, to be built by Ar-Mex Pipe Line Co., will be 18-in. and will run from Guernsey to Coolidge through Albuquerque. It will have a 50-mile, 8-in. lateral north of Denver to gather crude from the Brush area of Denver-Julesburg basin and a 90-mile, 8-in. branch north of Albuquerque to pick up oil from the Farmington, N. M., area of San Juan basin.

Standard also plans a 330-mile, 16-in. crude mover from Wink, Tex. to Albuquerque. As plans are now, construction on the southern portion of the work will start before the first of the year while the northern portion will be forced to wait until next spring due to the more severe weather.

Another interesting crude line is Magnolia Petroleum Co.'s venture with Continental Oil Co., and Newmont Oil Co. to build a 48-mile, 12-in. line to gather oil off the coast of St. Mary's Parish, Louisiana. The line will be longest submarine pipeline ever laid and will be watched with great interest by all present and future ocean drillers.

In Canada, three big jobs involving crude are under way and a fourth one, while entirely in the United States, depends on Canadian building before it could be constructed.

Interprovincial Pipe Line Co. is looping 604 miles of its system with 24 and 26-in. pipe, 150 miles of which is being done by Lakehead Pipe Line Co., the U. S. subsidiary of Interprovincial.

Pembina Pipe Line Co., Ltd., is hard at work on gathering lines and one 72-mile, 16-in. transmission line to get crude from Pembina field to market.

South Saskatchewan Pipe Lines, Ltd., is building 150 miles of 16-in. from Fosterton field in Saskatchewan to connect with Interprovincial at Regina. This line is the northern portion of the system which will bring crude to the Great Northern Refining Co.'s refinery now under construction near St. Paul, Minn.

The southern half of this line, entirely in the United States, is being built by Minnesota Pipe Line Co. The line will be constructed of 16-in. pipe and will run 260 miles from Clearbrook to Hastings, Minn.

Pipelining, which has amazed many people in the industry since the end of World War II, undoubtedly will continue to do the same in the future.

Production people are making more hole to get more crude, refiners are sending more products to market, marketers are building more outlets to serve the people, and people are increasing everyday. Since crude uses the pipelines to get to the refineries and the refiners use the pipelines to get to market, how else can pipelining go but forward?

Is Oil Regulation by FPC Next?

- **Compact Commission speakers agree state conservation doomed unless Congress moves to curb FPC gas authority**
- **El Paso Natural president predicts regulation of oil by federal Government is next possible step**

Henry D. Ralph

OMAHA. — State regulation of oil production and conservation is doomed unless Congress amends the Natural Gas Act to exempt producers and reverse the effects of the Supreme Court decision in the case of Phillips Petroleum Co., the Interstate Oil Compact Commission agreed at its fall meeting here.

This was the main theme of three prominent speakers who minced no words in stressing the danger to conservation if the Federal Power Commission continues its present course of regulation of gas field prices and output as embodied in FPC Order 174-A.

The speakers were Edward F. Arn, governor of Kansas, Paul Kayser, president of El Paso Natural Gas Co., and J. C. Donnell, II, president of Ohio Oil Co.

Governor Arn opened the Compact meeting with a detailed discussion of the effect of the FPC order on independent producers. He reviewed many of the complaints which producers already had made to FPC in their individual petitions for rehearing *(The Oil and Gas Journal, August 30, page 46 September 6, page 58)*.

For many years, Arn said, Congress, the courts, and FPC agreed that regulation of gas pipelines should not interfere with state regulation of oil and gas production and conservation, but in the Phillips case, "the Supreme Court, in one mighty sweep of the pen, nullified 20 years of progress."

The Kansas governor quoted The Oil and Gas Journal editorial of August 2 which suggested that FPC really hopes to induce Congress to amend the act by demonstrating how impractical it is to regulate production, and then commented, "this might be the correct diagnosis, and if so there may be some hope."

A long list of reasons why the FPC order is illegal was given by Arn, a former attorney general and justice of the Supreme Court of his state. He said this is not a contest between producing states and consuming states, as some people carelessly assume, but is a question of adequate supplies of gas for all.

"There is little doubt, I am sure," Arn said, "but that producers will exercise the escape clauses in their contracts and will not negotiate new contracts with interstate lines, thus expecting to keep out of the jurisdiction of the Federal Power Commission.

"The only ultimate outcome of such a situation would mean less gas to the eastern states and consequently much higher prices to the consumers there.

"If the producers continue to ignore the interstate gas companies and serve only local concerns, the outcome will be disastrous. The supply of natural gas to local concerns will quickly exceed the demands; the price of gas will therefore decrease to local consumers; production of marginal wells will cease; exploration for new fields will dwindle; and the natural-gas industry will be back to its original status."

Regulation conflict . . . On this same theme, Donnell said that the Phillips decision has brought into focus the inevitable conflict between state regulation of production and federal regulation of sales. He urged the Compact Commission to take the lead in preserving the existing system of state conservation of oil and gas.

"Even if federal action goes no further than controlling the sales of natural gas," he said, "continual conflict between the Federal Power Commission and state regulatory bodies seems inevitable. Let's not forget that one-third of the natural gas produced is casinghead gas, and the volume of casinghead gas is directly dependent on crude-oil production rates."

The most forceful and explicit condemnation of FPC interference was that delivered by Paul Kayser, whose company is one of the largest purchasers and transporters of gas produced along with oil.

Haste needed . . . He urged that everything possible be done to delay enforcement of Order 174-A until Congress can act on amendments to the Natural Gas Act. The longer federal control continues and the deeper it penetrates, the harder it will be to get it relaxed, he warned.

State regulation of conservation is doomed, Kayser said flatly, and unless the act is amended the Interstate Oil Compact Commission will be displaced. In support of this conclusion Kayser said:

"State regulation of conservation of oil and gas resources will necessarily ultimately be displaced by federal regulation. Both agencies cannot exercise jurisdiction in the same field over the same subject matter without conflict, and we all know that, in case of a conflict between state authority and federal

Industry spokesmen leveled a steady barrage of fire at the FPC's newly assumed authority over natural-gas producers last week and at the New Orleans meeting of the Independent Natural Gas Association two members of the FPC made a cautious defense of their agency's actions with the reminder things could be even worse. **See page 135.**

Jerome Kuykendall, chairman of the Federal Power Commission, attended the meeting of the Interstate Oil Compact Commission in Omaha last week and listened to repeated denunciations of his agency without any comment, public or private, except to say:

"There is a difference between arguing what the law is and what it ought to be."

The Compact Commission adopted a resolution expressing "deep concern" over the effect of the Phillips decision in the Supreme Court and actions taken by the Federal Power Commission since the decision. The resolution asked Congress to amend the Natural Gas Act "to make it clear" the FPC has no authority to fix prices paid to the "producer and gatherer of natural gas. . ."

authority, the state authority will be stricken down."

Kayser insisted "this is not mere talk" and cited a case pending before the FPC in which the city of Chicago seeks to compel the producers of La Gloria field in Texas to deliver gas to the Texas-Illinois pipeline instead of using the gas for repressuring the field. Chicago bases its case on the jurisdiction granted the FPC in the Phillips decision.

The next step, Kayser said, would be general FPC authority over producers of oil because the federal agency would be called upon to decide whether or not oil producers should use their gas for repressuring or sell it in interstate commerce to supply demands of markets within FPC jurisdiction.

"Under these circumstances, it is inconceivable that the ultimate result will be anything else than federal control of the production of oil as well as the production of gas."

By the same logic, Kayser said, the price of coal would eventually be fixed by the federal Government because both gas and oil compete with coal as a heating fuel.

Approaching the regulation theory from a different direction, Kayser reached the same conclusion. If the Government regulates the field price of gas, then it would also "follow" that it must regulate the price of gas sold for intrastate commerce (just as the Interstate Commerce Commission regulates intrastate freight rates).

"Obviously, two prices—an interstate regulated price and a state-regulated or free intrastate price—participated in by the same producers cannot exist in the same field at the same time without discrimination.

"To correct the discrimination, the Federal Power Commission will be the one to fix the price for both classes of gas. It certainly seems, in the light of past experience, that anyone would have to be very naive to reach any other conclusion."

Liquid products . . . Kayser pointed out that the FPC is now considering the question of regulating the price of liquid products produced in connection with natural gas. Nearly all casinghead-gas contracts, he said, provide for payment of a percentage of the liquid products value in addition to all or a part of the sale price of the residue gas. This value on casinghead-gas cannot be fixed "except at the same time fixing the value or price of these liquid products—gasoline, butane, propane."

"The prices of these products, particularly gasoline, cannot be effectively fixed unless the price of crude oil, from which the vast preponderance of gasoline is made, is likewise fixed. This vicious chain reaction, once started, is like atomic reaction, extremely difficult to control."

Kayser urged the oil industry to impress on the general public that the nation's economy, defense, and standard of living, depend on the energy derived from oil and gas, and that if reserves are not kept well ahead of consumption the result will be disaster.

"The only thing that stands between the nation's economy and such disaster is the continuous, intelligent, aggressive exploration for additional reserves of oil and gas," he declared. "If this is tampered with, hindered, or in any manner curtailed by regulation by anybody, no matter how good their intentions may be, the country will face a serious loss of energy and a curtailment of its standard of living."

Nothing Slow About This Fellow

WASHINGTON.—Producers of natural gas generally have been slow complying with the Federal Power Commission's recent order requiring them to file for certificates to supply interstate pipelines. Such is not the case with Rex C. Cauble.

Cauble, an independent producer doing business as Texas State Drilling Co., jolted FPC officials by filing an application when it wasn't required.

Since the FPC is not exactly overburdened with applications, its staff got right to work on Cauble's filing. FPC counsel, shocked to learn that Cauble's production wasn't under the agency's jurisdiction, recommended that his application be dismissed.

Officials explained that Cauble produces gas from the South Rankin field in Harris County, Texas, and sells it to United Gas Pipe Line Co. Their investigation convinced them that all of his production is consumed in Texas, and since it doesn't cross a state line the FPC assumed a hands off policy.

Proration Championed

Interstate Oil Compact Commission speakers, committees urge Rocky Mountain states to adopt conservation laws

OMAHA.—Strong pressure was put on the Rocky Mountain states to adopt proration laws by representatives of other states at the meeting of the Interstate Oil Compact Commission here.

In the anticipation that the legislatures of Colorado, Wyoming, and Nebraska will have conservation laws before them next spring, speakers at both general sessions and committee meetings mustered an array of arguments to show how proration would help both those states and the nation as a whole.

J. C. Donnell, II, president of Ohio Oil Co., made this the theme of one of the principal addresses at the meeting. It was also discussed at length in the legal and regulatory practices committees.

The problem, said Donnell, is to instill a will to conserve in the people of the states and in the hearts and minds of the legislators and state officials throughout the area.

"I would like to urge the commission and its individual members to use their persuasive powers and moral support in helping to obtain the legislation needed," he said.

No longer is the Rocky Mountain area isolated from the economy of the rest of the petroleum industry, Donnell declared. He pointed out that within a few months the region will have pipeline outlets to the east for more than 400,000 bbl. daily of crude oil, plus internal refining capacity of 275,000 bbl. daily, plus products pipeline outlets to the Northwest. This is a greater total outlet than present crude production, but exploration and producing capacity are expanding rapidly.

"In the future, the fortunes of the area will be closely dependent upon those of the industry as a whole, and operations throughout the territory will have an increasingly greater impact on the entire industry," Donnell said.

Share responsibility . . . Donnell warned that the Rocky Mountain area must share with other producing states the responsibility of providing a continuous supply of oil for the United States. One factor in this, he said, is developing and maintaining an excess productive capacity to give a margin of safety for the country's security.

So far, Donnell reminded, there is a substantial safety margin of production but it is concentrated in states with

adequate conservation laws. He advocated a more proportionate distribution of the excess capacity among important producing areas.

Observing that reluctance to initiate conservation may be in part a natural fear of the consequences of restriction, Donnell declared:

"Conservation, far from limiting progress in the states where it has been practiced, has produced a stronger and more flexible industry, and the individual states themselves have benefitted greatly through increased recoveries."

He told the Compact Commisison its "missionary" work will not be complete until all producing states are members and all are practicing conservation. He said this would also give the compact the necessary unity to resist the "encroachment of federal authority".

Colorado law attacked . . . Colorado representatives were put on the defensive by the legal committee at its session on proration in the Rockies.

Warwick M. Downing, chairman, and Wilbur Rocchio, attorney, of the Colorado Oil and Gas Conservation Commission championed their state law which gives the commisison broad powers to prevent waste but defines no specific methods or procedures. They contended that this permitted more flexibility than the laws of states which spell out market-demand proration and other particular methods of preventing waste. They admitted that the Colorado law has still to pass the test of judicial review.

Other members of the legal committee, particularly its chairman, Ernest O. Thompson, chairman of the Railroad Commission of Texas, explained that other states have tried this without success because the courts will not uphold broad delegation of powers to a regulatory body. The history of state conservation, they said, follows a definite pattern, and has not been successful until the statutes specifically authorize all necessary methods, including proration to market demand.

As a result, the legal committee agreed to undertake a study of the Compact Commission's model state statute in the light of all court decisions relating to conservation. This study will be presented at the December meeting of the Compact Commission in Chicago and presumably will have a bearing on the type of legislation to be presented to the Colorado Legislature in January.

The meeting of the regulatory practices committee also was devoted entirely to market-demand proration.

I. N. McKinnon, chairman of the Alberta Petroleum and Natural Gas Conservation Board, described in detail the system used in his province. It was modeled on the experiences of several Compact member states, and he said the system is working effectively.

Proration plea . . . This was followed by a hard-hitting plea for proration in the Rockies by William J. Murray, Jr., member of the Railroad Commission of Texas.

There is no way to attain conservation, he said, except to have proration, which means equitable distribution of production among wells with a ceiling set by maximum efficient rate of production and by market demand, whichever is lower.

Experience has shown that it is futile to try either MER or market demand without the other, Murray insisted, and if the Rocky Mountain states are not yet willing to adopt both at once they will suffer what Texas went through years ago when conservation was not effective.

Turning to market-demand proration, Murray gave a rapid-fire listing of its benefits:

. . . It prevents waste from excessive aboveground storage and also underground waste because surplus production leads to inequitable pipeline proration, loss of markets to stripper wells, and premature abandonments.

. . . It stabilizes prices by eliminating violent fluctuations without raising the level of petroleum prices above that of the general commodity price index.

. . . It brings lower average prices to consumers and higher average prices to producers because rapid and unrestricted production requires unnecessarily large transportation and storage facilities and fast amortization of producing facilities.

. . . It makes oil production a bankable operation because capital can be obtained when investors are assured that reserves will be protected and that crude will be marketed in an orderly fashion over the expected life of the field.

. . . It provides an incentive for exploration and wildcatting through assurance of a market outlet for all new production.

. . . It builds markets by assuring a dependable supply at reasonable prices.

. . . It protects consumers and the national security by providing a reserve producing capacity at all times.

. . . It justifies the oil industry in asking for protection against excessive imports and for continuation of the 27½ per cent depletion allowance.

. . . It is not a conspiracy, not an antitrust violation, not a price-fixing device, and the industry should preach, practice, and defend market-demand proration universally and continually.

Law Change Urged

I.N.G.A.A. unites in plea for Natural Gas Act revise

NEW ORLEANS.—The entire natural-gas industry is united in the opinion that the Natural Gas Act must be amended to exempt producers from federal regulation.

This was evident at the tenth annual meeting of the Independent Natural Gas Association of America here last week. A strongly worded resolution supporting this view was adopted by the association which represents transmission companies, local distributors and gas producers.

The need for early revision was stressed by several speakers and was made the primary theme of the association's enlarged public relations program.

The resolution urged Congress to take prompt action at its next session to "free production of gas from the injurious burden which has been thrust upon it by judicial mandate" of the Supreme Court in its Phillips Petroleum Co. decision.

C. P. Rather, president of Southern Natural Gas Co. and outgoing association president, pointed out that the Phillips decision has "confused" the entire industry, the Federal Power Commission, and the public.

"It seems as if it were the court's intention to force this problem before Congress," Rather said. "In any event it is apparent that the situation in which we find ourserves must be clarified and to do this will require legislation."

W. E. Wilson, of United Gas Corp., Shreveport, chairman of the association's public information program told the assembled gas men they must "tell our story to the millions of natural-gas customers." Wilson urged that the public be convinced it is more in the public interest that adequate supplies of gas be available at attractive prices than inadequate supplies at bargain prices. To insure this adequate supply, Wilson said, the public must realize that all segments of the industry are entitled to the incentive of a fair profit in bringing gas to the consumer.

New officers . . . Officers elected for the coming year were: President, J. F. Merriam, president of Northern Natural Gas Co., Omaha; first vice president, J. J. Hedrick, president of Natural Gas Pipeline Co. of America, Chicago; second vice president, Glenn Clark, president of Cities Service Gas Co., Oklahoma City; treasurer, F. W. Peters, treasurer of Oklahoma Natural Gas Co., Tulsa.

FPC Members Tell Gas Men:

. . . Things Could Be Worse

Henry D. Ralph

NEW ORLEANS. — Representatives of the Federal Power Commission made it plain at the Independent Natural Gas Association of America meeting here last week that they fully realize the magnitude of the problems posed by the Supreme Court decision in the Phillips case, but asked the gas industry to use patience and cooperation in meeting them.

Both Commissioners S. L. Digby and Willard L. Gatchell attended the session. They admitted Order 174-A may have its shortcomings—but warned the producers could be in worse shape if the commission had not drafted the order.

They defended FPC Order 174-A as being the most practical course under the circumstances, and as representing the least amount of regulation of gas producers possible under the law. They hinted that if this order is set aside or ignored, gas producers run the risk of finding themselves subjected to even more onerous provisions of the Natural Gas Act and of older regulations designed specifically for pipeline companies.

They also expressed the hope that the Phillips decision will be modified or set aside either by the Supreme Court or by congressional amendment.

Judge Digby delivered a guarded and almost cryptic address which raised more doubts than it settled as to what may happen to producers if the law is not changed.

Gatchell subjected himself to interrogation by William J. Tarver, general counsel of Southern Natural Gas Co., Birmingham, and formerly assistant general counsel of FPC. Gatchell spoke extemporaneously, emphasizing that he was giving off-the-cuff personal opinions which he might change later, but he hedged his answers so carefully that his remarks boiled down to advice to follow Order 174-A completely until the situation is clarified.

Change not welcome . . . Digby, Gatchell, and Tarver all emphasized that FPC did not welcome the Supreme Court's reversal of FPC's historic position that producers are not subject to the act, but that the commission reads the Phillips decision as making all producers selling gas into interstate commerce "natural gas companies" as a matter of law.

As such, producers are subject to all the penalties of the act and to all regulations designed for pipelines, except to the extent that FPC can exempt or protect them. Tarver explained that it was the court, not the commission, that brought producers completely under the act, and that FPC's Order 174-A covers only the commission's mandatory powers, not its additional discretionary powers.

Digby said the commission had no rules and regulations that could be "reasonably" applied to independent producers when the Supreme Court ruling placed the producers under FPC jurisdiction, adding that the commission would have been shirking its duty had it not prepared a set of regulations.

Gatchell added that when the Supreme Court refused July 16 to stay its mandate in the Phillips case, the FPC issued its first order as a guide for the independents to follow rather than let the producers flounder along and comply with the law as best they could.

Protection in order . . . Gatchell declared that it was the court decision, not Order 174, that "froze" field prices of gas. Without this order, he explained, producers would have no legal way to change price, but under its terms they can do so by filing an application. Producers have technically been in violation of the act since 1938, he insisted, but Order 174 saves them from penalties if they comply as of June 7.

Both Gatchell and Digby expressed the hope that the Supreme Court will rehear the Phillips case in October and Digby added: "It is my considered judgment that the public interest requires changes in the Natural Gas Act."

What could develop . . . Digby quoted several provisions of the Natural Gas Act which have not been applied to producers by FPC, but which suggest some of the problems confronting the commission.

This raised speculation among his listeners as to whether he was trying to demonstrate that the act was written for pipelines rather than producers or was forecasting still more drastic regulation yet to come.

Digby mentioned section 4 (B) which prohibits a natural-gas company from discriminating among purchasers as to price or service; section 7 (A) which permits FPC to direct a company to enlarge its facilities or to sell gas to any designated purchaser; section 7 (B) which prohibits abandonment of facilities or service without FPC approval; and section 7 (H) which gives a natural-gas company the right of eminent domain to condemn property needed in the conduct of its business.

Role of states . . . Interference wih state conservation laws was also listed by Digby as a serious problem posed by the Phillips decision and he said: "The wisdom of state conservation laws administered by state agencies is established and generally accepted. The matter of conservation of irreplaceable oil and gas is primarily the right and responsibility of the respective states."

In answer to a question on the same subject, Gatchell said that FPC does not have power to regulate the production and conservation of oil and should not have power to regulate gas production under a reasonable interpretation of the division of state and federal powers. However, he would not predict where control of casinghead gas will ultimately lie.

Referring to the FPC hearing on Order 174-A, September 22, Gatchell urged producers not to waive their right to file briefs, saying that the commission needs all the advice and supporting arguments it can get and that protestants will be in a better legal position later if they make a full statement of their objections now.

Prescribed procedure . . . Gatchell also warned that if Order 174-A is set aside, producers will be subject to all the terms of the law as natural-gas companies. He said if producers think 174-A is burdensome they should take a good look at what might apply to them in its absence.

The question of what producing and gathering facilities, if any, are covered by the act cannot be answered yet, but will soon be before the commission for determination, Gatchell said. The Phillips decision did not deal with facilities but made it plain that a sale of gas for interstate movement is not a part of production and gathering but does make the seller a natural-gas company, he explained.

The safe course for producers, Gatchell said, is to assume that Order 174-A does not go farther than its language. It requires a certificate for sale of gas, but not for facilities to perform the service. If it is determined that facilities must be certificated, a producer will be protected against penalty if he has previously applied for a certificate of service under Order 174-A.

Gatchell was asked a series of ques-

tions about various types of field operations and sales arrangements, and his general advise was: In case of doubt play safe and file with FPC because nothing will be lost if FPC jurisdiction is later determined not to apply.

Discussing casing-head gas contracts, Gatchell said an important aspect of the law is protection of the continuity of supply of a pipeline and that this is very hazardous in the case of casing-head gas. This left the inference that FPC may feel it necessary to take jurisdiction over casing-head production and well-head sales.

Gatchell was asked the validity of escape clauses under which producers can cancel contracts if FPC changes their rates. He replied that such clauses are proper, but that the Supreme Court said that as of June 7 all producers became subject to the act by reason of making interstate sales.

Escalator clauses . . . Discussing escalator clauses and other contract provisions for automatic or periodic price increases, Gatchell said that these were valid arrangements, but that the fact of a contract did not tie the hands of Congress and the act permits a rate increase only with approval of FPC. He said it may be that FPC may hold that escalation is a valid part of a rate schedule, but until then every increase must be applied for separately.

The FPC staff has recommended that all state production taxes which increase the costs of producers be treated as legitimate expense and that rate increases be allowed to cover them. Gatchell indicated, however, that until the commission rules otherwise, all producers should make individual applications for rate increases to cover such additional taxes.

Export Pact Urged

NEW ORLEANS.—A plea for the United States and Canada to work out a program for free exchange of gas and oil was made here during the Independent Natural Gas Association meeting by N. E. Tanner, president of Trans-Canada Pipe Lines, Ltd.

Tanner, former Minister of Mines for Alberta, declared "man-made barriers" should not stop the flow of natural gas over the United States-Canada border. He was referring to the recent refusal of the Federal Power Commission to permit Westcoast Transmission Co. export Canadian gas into the Pacific Northwest area.

In connection with Westcoast case, Tanner pointed out the Peace River area of Canada has gas reserves in excess of 4 trillion cubic feet. He said the northwestern states are a "natural market" for this gas. The refusal to permit exportation of the Canadian gas into the United States "is a condition which need not and should not exist," he said.

Crude Forecast Cut

I.P.A.A. shaves production estimate 46,000 bbl. daily

CRUDE production for the year is now forecast at 6,400,000 bbl. daily by the Independent Petroleum Association of America. This represents a decrease of 46,000 bbl. daily from the earlier estimate in May.

The revision was disclosed by H. B. Fell, chairman of the I.P.A.A. supply and demand committee, at the quarterly meeting of the Interstate Oil Compact Commission in Omaha.

Fell called attention to the fact that total product demand during the summer months has been running substantially below levels estimated by the committee in May.

Curtailed domestic production resulted in reduced total petroleum supply during the summer months, but the cut was not in proportion to the unexpectedly lower demands. As a result, inventories continued at high levels.

Stocks estimate . . . Total oil stocks for September 1 were estimated by Fell at almost 760,000,000 bbl. or about 25,000,000 bbl. above last year.

Crude production for the September-November period was estimated at 6,340,000 bbl. daily, based on the following controlling factors: (1) Total inventories no higher than last year by November 30; (2) scheduled imports no higher than the totals reported to the Texas Railroad Commission in August; and some increases in total demand over last year but about 1 to 2 per cent below the committee's May forecast.

Fell estimated average crude productive capacity during 1954 at 8,100,000 bbl. daily compared with forecast production of 6,400,000 bbl. daily. Annual expansions in productive capacity have been averaging about 300,000 to 400,000 bbl. daily.

"From a practical, economic standpoint," Fell said, "it is impossible to continue such expansion and, at the same time, carry a larger and larger shut-in or idle production.

"There is no doubt in my mind that the expansion of domestic oil supplies cannot continue at recent rates if imports continue to supply more than 1,000,000 bbl. per day of the U. S. market," Fell concluded.

Oil Shale Report

Bureau of Mines research summarized for A.I.Ch. E.

GLENWOOD, Colo. — The Government's 5-year experimental program with oil shales at Rifle, Colo., ended in June but not before it proved thermal cracking of crude shale oil, followed by sulfuric acid treatment of naphtha, is technically feasible for producing gasoline.

The data collected by the Bureau of Mines at Rifle was summarized last week in a paper presented by Boyd Morris and R. J. Cameron at the American Institute of Chemical Engineers symposium on oil shale here.

Colorado shale oil produced by the gas-combustion retorting process is about 200 A.P.I. gravity, containing almost no material in the gasoline boiling range. Catalytic cracking of the crude stock is not practical because of the high content of nitrogen compounds which have a detrimental effect on the activity of cracking catalysts. Thermal cracking seems to be the most applicable method for refining shale oil to make a regular grade gasoline.

Since thermal cracking equipment is already part of existing facilities at most refineries, these might be used to process shale oil in time of emergency, thus avoiding construction of entirely new plants.

Facilities . . . Experimental facilities at Rifle consist of a cracking plant with a capacity of 150-300 bbl. per day. This is a conventional single-coil Dubbs with a reaction chamber. The treating plant has a capacity of about 150 bbl. per day. It is a continuous unit that can handle naphtha or other distillate products. Primary treating is in six extraction stages in series. The first is for tar-acid extraction, the second for tar-base extraction, the next three for concentrated-acid treating, and the last for water washing and neutralization.

Thermal visbreaking of crude shale oil was also investigated at Rifle to reduce pour point and viscosity which would make pipeline transportation of the crude shale oil feasible. Chamber coking was investigated with good results and it is believed that the newer contact coking and fluid coking processes would be equally applicable.

In addition to the Bureau of Mines some private companies have been doing work with shale processing aimed at making motor fuel. Other companies have shown interested in shale as a source of chemicals.

Lube Exports High

N.P.A. head says demand to shift, but will be sustained; Thompson predicts U. S. oil consumption to double by '75

George H. Weber

ATLANTIC CITY. — International trade received considerable attention during the fifty-second annual meeting here of the National Petroleum Association, with lube exports capturing much of the limelight.

A 100 per cent increase in United States oil consumption was forecast during the session by Lt. Gen. E. O. Thompson, chairman of the Texas Railroad Commission, while Chester F. Smith, Standard Oil Co. (N. J.) vice president, outlined the future international refining lineup.

A. W. Scott, N.P.A. president and president of Wolf's Head Oil Refining Co., declared none of the increase in lube oil exports this year resulted from shipments behind the Iron Curtain. The current boost, which for the first half of 1954 was 33 per cent over the same 1953 period, is due primarily to increased industrial activity throughout the free world.

More dollars are available for United States lube imports, Scott said, and depressed prices in this country have attracted new business abroad. While expressing confidence that industrial activity abroad should remain high, sustaining this demand, Scott also pointed to the temporary nature of some of the present demands.

Lube stocks have been low in the free world outside the United States as consumers cut back imports anticipating completion of their own production. It appears that some European refineries have met mechanical difficulties and have not come on stream with full production, he said. This has given rise to a sharp, but probably temporary increase, in United States lube exports.

Production needs stimulus . . . Strong arguments supporting state conservation of petroleum and retention of the present depletion allowance were voiced by General Thompson. He said the United States is producing 6,400,000 bbl. daily and importing around 1,000,000 bbl. Productive capacity from wells already drilled is 1,600,000 bbl. daily above current production.

General Thompson said the only dependable defense reserve is in wells already drilled and producing below the maximum efficient rate. He said the United States cannot depend on undrilled land for defense measures, adding that the margin from drilled wells producing below maximum is not sufficient to meet United States and Allied demands in a national emergency.

Declaring that the depletion allowance is the incentive that continues the exploration and drilling of wells, he concluded that this is no time to tamper with anything that might affect our national security. Rather, said Thompson, we should be hunting ways to further stimulate domestic production.

A close study of past increase in consumption tied in with population increase projected to 1975 led Thompson to predict that United States consumption by that year will reach 12 to 14 million barrels of oil per day, double our present daily production and imports.

He said additional production will come from new discoveries, better recovery methods, secondary recovery, increased use of butane and propane as motor fuels, conversion of natural gas to gasoline, and imports.

Refining rundown . . . Smith traced the emergence of the Middle East and the gravitation of refineries to consuming areas during the past decade.

In the free world outside United States, refining capacity has increased from 2,600,000 to 5,908,000 bbl. per day, a boost of 127 per cent, he said. This will move upward to almost 7,000,000 bbl. per day in roughly 3 years, when facilities now being planned or built are completed—and when Abadan has reached about 250,000 bbl. per day. By that time, United States capacity will be almost 9,125,000 bbl. per day, Smith said.

There is little likelihood that United States refiners will ever recapture much of the lube and fuel markets they formerly had in Europe and other foreign markets. But, the domestic industry is healthy, the nation is expanding, energy needs are growing, and oil is the best and most convenient energy source yet developed, he said.

Jersey forecasters expect the annual rate of domestic increase in the oil business will be about 4 per cent for the next 5 years, he added.

For the extended future, the industry must recognize atomic and solar energy possibilities, he said. There is no need to fear their coming, for it will be a very, very long time before many autos and trucks are powered by nuclear reactors or our northern homes heated with sunshine alone. The availability of new energy sources will turn new attention to converting more oil and natural gas to chemical and other nonfuel uses, he declared.

Big Union Approved

Oil-chemical organization may become one of largest

ST. LOUIS.—Plans of C.I.O. leaders to organize workers in oil and allied industries into one of the nation's largest unions gained momentum last week as United Gas, Coke and Chemical Workers voted overwhelmingly in favor of a merger with International Oil Workers Union.

The merger plan, previously approved by a joint committee representing the two C.I.O. groups, will be presented to the Oil Workers at their convention opening in Cleveland November 15. If the merger is approved by the Oil Workers, it will be put into effect at a joint conventiton to be called later.

The Gas, Coke and Chemical Workers voted 667 to 192 in favor of merging after the plan was endorsed by Walter Reuther, C.I.O. president. Also backing the proposed combine were O. A. Knight, president of O.W.I.U., and Elwood D. Swisher, president of the Gas, Coke and Chemical Workers.

Membership of the new union would total about 200,000 workers, of whom some 130,000 are now represented by O.W.I.U.

Strengthening of the Oil Workers through amalgamation is expected to add impetus to the drive to mold independent unions into the larger organization. Some labor leaders have envisioned a giant million-member union representing oil, chemical, and allied workers in both the United States and Canada.

Following ratification of the merger by his organization, Swisher pointed out that the new union has a possibility of becoming "the biggest in the nation."

Fracturing Boosts Ohio Test

COLUMBUS.—What is probably the largest initial production of any Clinton (Silurian) well in Ohio is reported in Hocking County in an area most operators thought to be condemned by dry holes.

Swartz, Adair et al 1 Harry Stone in Section 34, Washington Township, logged pay sand at 2,763-94 ft. The well flowed 17 bbl. daily naturally and was increased to 1,200 bbl. with 700 M.c.f. of gas in a 24-hour test after fracture treatment.

Stripper Rule Asked

Oklahoma operators seek new production formula

OKLAHOMA CITY.—A new oil-production formula for stripper wells in Oklahoma has been proposed for inclusion in the Corporation Commission's revised allowable regulations.

The proposed yardstick, submitted by a committee headed by K. W. Bolt, of Stanolind Oil & Gas Co., would set allowables on stripper wells on a lease basis. Allowables would be established by multiplying the number of wells on a lease by the maximum stripper-well allowable, which is yet to be determined.

The proposal was presented at a meeting called by O. P. Nicola, Phillips Petroleum Co., to reconcile objections to the production formula devised earlier by a committee appointed last winter to help modernize the Oklahoma allowable system. Nicola heads a subcommittee on general rules and regulations.

Under the new formula, the stripper-well classification would replace the present unallocated classification. It would permit a more accurate estimate of unallocated production and thereby aid in ascertaining the amount of oil to be prorated from other fields.

The group also went on record for enforcement of the rule requiring operators to file intention to drill before starting a new well. Under the suggested rule, production allowables would be withheld for 30 days if a well were drilled without notice having been filed.

Harbor System Finished

PHILADELPHIA. — Harbor Products System has gone into operation after a delay of several months due to right-of-way difficulties.

The 80-mile, 16-in. line, which has been certified as a national defense facility by the Government, connects three refineries, Gulf Oil Corp.'s Philadelphia refinery, Sinclair Refining Co.'s Marcus Hook, Pa., refinery, and The Texas Co.'s Westville, N. J., plant, to terminals in the New York City area.

The Harbor System is owned by Gulf Refining Co., Sinclair Pipe Line Co., and Texas Pipe Line Co. The line was built and will be operated for the owners by Sinclair.

Indian Land To Be Leased

PAWNEE, Okla.—Bids for oil and gas leases on 2,129.29 acres of restricted Indian lands in Oklahoma will be accepted by the Pawnee Indian Agency October 4.

Leases will be offered by the Interior Department on 29 tracts ranging up to 160 acres in size. The tracts are in Kay, Noble, Pawnee, and Payne counties.

Industry Briefs

OKLAHOMA CITY.—Mercury Oil Refining Co., operator of a 3,500-bbl. daily refinery here, has cut its price for crude oil 25 cents a barrel. A company spokesman said the present high stocks of refined products do not justify the former crude price. The reduction drops Mercury's price to $2.65 a barrel for 40° gravity and above oil with a 2-cent differential for each degree of gravity to a base of 20° gravity. The company buys about 1,500 bbl. daily in Central Oklahoma.

TULSA. — Oklahoma Natural Gas Co., Tulsa, and Consolidated Gas Utilities Corp., Oklahoma City, have dropped a proposed stock exchange merger.

BATON ROUGE.—Louisiana Conservation Commissioner John B. Hussey announced last week the state's daily oil production allowable for October will probably be set near the September figure of 592,000 bbl. The allowable has dropped monthly since April. The figure will be determined September 23.

WASHINGTON.—Bids for lease on 192.73 acres of land within the known geologic structure of Hell's Hole Canyon field will be opened by the Bureau of Land Management September 29. The area is in Rio Blanco County, Colorado, about 55 miles north of Grand Junction.

CANADA

Canadian Guide Revised

HALIFAX, N. S.—A revised edition of the Bank of Nova Scotia's compact reference guide for oil and gas companies entering Canada's four western provinces is now available through the various branches of the bank.

The booklet covers such general items as taxes and depletion allowances, border regulations covering personnel entering the country and import regulations and duties. There is also a section explaining the functions and organization of the Canadian Petroleum Association.

For each of the four western provinces, Manitoba, Saskatchewan, Alberta and British Columbia, there is a comprehensive breakdown of regulations covering permit and lease acreage, geophysical and drilling operations, royalties, production and other matters.

Gas Market Sought

Canadian firm is seeking new outlet in California

CALGARY, Alta.—Westcoast Transmission Co., whose proposal to pipe Canadian natural gas into the Washington-Oregon area was turned down by the Federal Power Commission in June, is seeking a new market in California.

If the company is successful, gas from Canada's Peace River region would supplement that from the San Juan basin in New Mexico and Colorado—source of the supply now scheduled for transmission to Pacific Northwest markets.

California utilities, getting the major portion of their gas through El Paso Natural Gas Co. from the San Juan basin, are said to be worried about future supplies now that part of the San Juan production will be diverted to the Northwest.

Three of California's chief gas distributors—Pacific Gas & Electric Co., Southern California Gas Co., and Southern Counties Gas Co. of California—have made arrangements to increase their purchases by 200,000 M.c.f. daily by the fall of 1957. Most of the additional gas is to come from the San Juan basin.

Reluctance to let imported gas compete with domestic supplies was given as a primary reason for the FPC's decision to grant Pacific Northwest Pipeline Corp. the concession in Northwestern states *(The Oil and Gas Journal, July 5, page 84)*. The other five applicants, including Westcoast Transmission, proposed to serve the area with Canadian gas.

If Westcoast Transmission is successful in lining up adequate markets along the lower West Coast, it is expected to apply to the FPC for permit to construct a line into that area. Cost of the project is placed at more than $100,000,000.

Gold Star Seeks More Rigs

REGINA, Sask.—Gold Star Drilling Co., Ltd., of Regina, last week was negotiating for the purchase of Hawke Drilling Co., Ltd., also of Regina.

Through the transaction, Gold Star would acquire three drilling rigs, bringing its total number of rigs to six. Negotiations were reported nearly complete, but purchase price was not disclosed.

Oil Show Expands

Permian Basin exposition at Odessa expected to attract more than 400 exhibitors, 150,000 visitors in 4-day run

ODESSA, Tex.—New grounds, greater attendance, more-elaborate exhibits and nearly twice the number of exhibitors, are in prospect for the 1954 Permian Basin Oil Show here October 14-17.

The number of exhibitors is expected to pass 400, compared with 228 who displayed equipment at the last show in 1952.

Termed the "Oil Field Workers' Show," the attraction anticipates an attendance of about 150,000 during its 4-day run. Most of these are expected from within the Permian basin.

The show this year will be held on a new 66-acre site about 3 miles north of downtown Odessa. The new site will provide adequate parking space in addition to roomier quarters for exhibits and special attractions.

Construction workers are racing against time in an effort to complete the huge Oil Show Coliseum building sufficiently to permit at least limited use of the structure during the show. The coliseum, claimed to be the third largest structure of its type in the world, will be 200 ft. wide, 300 ft. long, and 80 ft. high. It is visible more than 10 miles from Odessa.

Exhibits . . . So far more than 300 exhibitors from 24 states have confirmed reservations for space. The exhibits will present the latest developments in equipment and techniques in exploration, drilling, completions, corrosion mitigation, pumping, conservation, transportation, and processing.

One of the most impressive is the world's largest aerial survey map. The map covers a large portion of the surface area of the United States and required 25 years to produce.

An 8-ft. model of a barge-mounted rig which has been used at Sowela Tech at Lake Charles to help turn out about 2,500 trained drillers and roughnecks will be on display. All parts and equipment are exact miniature replicas of their counterparts on a full-size rotary. The little rig has drilled more than 50 ft. of hole.

One of the feature attractions of the show this year will be a reconstructed "Boom Town," which will be incorporated in a Permian basin oil-field museum after the show.

Several major producing and pipeline companies are reported to have volunteered men, materials, and know-how for the construction of this project. Items offered include false-front buildings, old service yards and camps, antiquated rolling stock, old wooden tanks, construction materials, one of the first rotary tables ever built, and an ancient cable-tool rig. The reconstructed boom town will boast old-time barber and print shops and a resurrected "Bijou" theatre. The Oil Industry Information Committee of the American Petroleum Institute plans to make use of the old theatre to show one of its newest movies, "The Story of Colonel Drake," dramatizing the story of the man who drilled the world's first commercial oil well near Titusville, Pa., in 1859.

How it started . . . The Permian Basin show was conceived in a series of meetings of Odessa oil and supply men in 1949. It was decided to hold the attraction during national Oil Progress Week in 1950. This first show attracted about 100 exhibitors and roughly 30,000 spectators. It has been repeated biennially since.

The 1952 attraction drew 228 exhibitors and a great many more visitors. The "Permian Basin" shows were not the first such oil-equipment exhibitions in Odessa, however. In the early 1940's, the city was host to two so-called "Little International Oil Shows."

THIS MODEL RIG, which will be on display at the Permian Basin oil show, has been used at Sowela Tech (sometimes termed Roughneck U.) at Lake Charles, La., to turn out 2,500 trained drilling-crew members.

Gasoline Plant Completed

ANDREWS, Tex.—Engine and vessel testing is now in progress at the new Midland Farms natural-gasoline plant under construction by Stanolind Oil & Gas Co. 14 miles southeast of here.

The new plant is scheduled to go on stream next week.

The plant will have an initial processing capacity of about 10,000,000 cu. ft. of gas daily from the 1,600-acre Midland Farms (Ellenburger) field. Provision for future expansion of capacity has been incorporated in the plant design.

No gas will be flared after the plant begins operation and residue gas will be reinjected into the Ellenburger. So far about half a dozen wells have been placed in injection service in the connection with pressure maintenance program in the field.

Contractor for construction of the plant was Gasoline Plant Construction Co., Houston.

Imports Flare Anew

Defense Department fears cutback would upset plans, bring high prices and shortages; I.R.A.A. head lists problems

Bertram F. Linz

WASHINGTON. — The smouldering controversy over oil imports flared up last week in three separate quarters of the Government.

A Defense Department report warned that if the United States is to be able to obtain essential petroleum products in event of a war it should take no action that would seriously injure our political and commercial relationship with the countries having petroleum reserves.

A large number of important organizations, including the Independent Petroleum Association of America, challenged the authority under which the United States has participated in the General Agreement on Tariffs and Trades and urged that the nation be not committed to further "one way" reciprocal trade agreements.

The Independent Refiners Association of America released a letter warning the President's Cabinet Committee on Energy Supplies and Resources Policy that imports as well as other questions of importance to domestic refiners must be considered in developing recommendations for a national fuel policy.

The Defense Department report, prepared as part of a coal supply study, said not only our defense but also the civilian consumer would be hurt if imports were eliminated since a residual fuel oil shortage would result. The report charged a substantial price increase in residual fuel oil—and probably on other petroleum products—would follow a cut in imports.

Refining trouble hinted . . . While admitting an additional supply of residual from domestic sources eventually would be available, the report argued a surplus of light products would result, forcing a revision of PAD Districts 1, 2, and 3 refining balances.

A shift in the PAD refining balances would force some refiners to operate below the efficient level since many of the current refining units are designed to reduce the yield of residual fuel oil.

The report also charged a shortage of aviation gas might develop by unbalancing the PAD refining setup.

I.R.A.A. letter . . . The I.R.A.A. letter written by M. H. Robineau, association president, to Mobilization Director Arthur S. Flemming, warned that the committee cannot be successful if it ignores vital, if small, segments of the oil industry or neglects their problems.

Robineau outlined a number of problems which he said must be resolved if the committee is to make comprehensive workable recommendations. They include:

. . . Problems and demand for regulations of imports.

. . . Preserving refining capacity adequate to the defense needs of the country "in such manner as not to destroy independent refiners and their capacity, as currently is happening."

. . . Whether state-controlled crude production and federally controlled imports do not also require some rationalization of refinery runs.

. . . Whether integrated company profits and reserves are subsidizing refinery and marketing losses of the integrated companies "to the detriment of a healthy domestic industry."

Gas Line Stymied

Producers balk at filing under controversial order

WASHINGTON. — Natural-gas producers have stymied American Louisiana Pipe Line Co.'s plans to build a Louisiana-Michigan transmission system by their reluctance to file for Federal Power Commission certificates under Order 174-A.

The FPC indefinitely postponed further hearings on the American Louisiana application after being told by counsel for the company that suppliers on whom the line would depend have stated they will not file for the certificates unless they are legally required.

Hearings on the application were recessed August 6 to give suppliers time in which to file for certificates to sell gas for interstate commerce. The commission later heard oral argument on the issue, then postponed the proceedings until further notice.

Issuance of a certificate was opposed by Panhandle Eastern Pipeline Co. It contended American Louisiana legally has no gas supply because of escape clauses in contracts with two of its six prospective suppliers and because producers involved have not filed for the required FPC certificates.

American Louisiana argued that there

Former Jersey Official Takes Oath

Conrad J. Bauer (left), former head of the foreign petroleum economics section of Standard Oil Co. (N.J.), is sworn in as assistant director for program of the Oil and Gas Division. Acting Director H. A. Stewart (center), gives the oath while C. C. Davison, acting chief clerk of the Interior Department, looks on.

is no competing application for its proposed service. It sought an immediate certificate pending further allocation hearings and eventual filing by the gas producers.

Tax Case Appealed

Company takes import tax suit to U. S. Supreme Court

WASHINGTON.—The Supreme Court has been asked to determine whether or not the 1939 Venezuelan trade agreement was legally revived when a later agreement with Mexico was canceled in 1950.

Metropolitan Petroleum Corp. took its case to the Supreme Court after the U. S. Court of Customs and Patent Appeals ruled against it. Metropolitan imported fuel oil from Curacao and was taxed at 21 cents per barrel after the Mexican agreement was canceled. The company contends the increase of 100 per cent in the tax over the 10½-cent rate of the Mexican agreement is in violation of the Reciprocal Trade Agreements Act which limits changes in duties and imports taxes to 50 per cent.

Customs Court reversed . . . The New York Customs Court, which first passed on the issue, agreed with the importer but the appeals court reversed that decision. The appeals court said Congress was aware of the existence of the Venezuelan agreement, suspended but not revoked when the 1943 agreement with Mexico was made, when it imposed the limitation on rate changes in 1945.

The agreement with Venezuela was made in 1939 and set up a system under which imports up to 5 per cent of the annual throughput of domestic refineries could be imported at a rate of 10½ cents per barrel, with the 21-cent rate applying to above-quota imports.

The Mexican agreement of 1943 superseded the Venezuela pact and provided for a 10½-cent rate on all imports without quota limitations. A proclamation by former President Harry Truman revoked that agreement in 1950 and revived the provisions and quota system of the Venezuela treaty.

Sights Raised on Bids

WASHINGTON.—Interior Department officials anticipate a minimum "take" of $50,000,000 next month from the sale of oil, gas, and sulfur leases in the outer Continental Shelf off the coast of Louisiana.

Minimum bonus on the approximately 1,250,000 acres offered for lease has

WATCHING WASHINGTON

Bertram F. Linz

More Tax Changes Ahead

A lot of tax news can be expected to be made in Washington next year.

Enactment of the general tax-revision bill by no means cleaned up the congressional slate of revenue legislation. A lot of issues, including the depletion rate to be allowed on oil and gas, will be brought up by the administration, members of Congress and private interests.

A big question mark still surrounds the five-point cut in the corporation tax rate scheduled to go into effect last April 1 but postponed for a year because of the Government's need for revenue. That cut would involve a loss of more than $3,000,000,000 and the Treasury already is facing a deficit of at least that much for the current 3-month-old fiscal year. It is questionable whether the Treasury will be willing to give up any revenue beyond that which will be lost through the tax cuts now going into effect.

Another big issue will be that of replacing the whole present excise-tax system with a general manufacturers' tax (in effect a general sales tax under a less politically objectionable name) which in the case of oil would be an alternative for the levies on gasoline and lubricating oil.

Also to be considered is the still unsolved problem of tax relief on foreign operations of American businessmen. A tax credit of 14 per cent was proposed this year but didn't get into the tax revision bill. Other issues include the elimination of the penalty tax on consolidated returns, reduction of the holding period or tax rate, or both, on capital gains, and the taxation of cooperatives and other exempt organizations.

Rubber Outlook Revised

Synthetic rubber production may be headed for an upturn.

A 24,000-ton surplus of natural rubber foreseen only a few months ago appears to have dissolved into thin air and there are now possibilities of an actual deficit which would call for more synthetic.

Under normal circumstances the long strikes in the Goodyear and Firestone rubber plants in July and August would have been reflected in a substantial volume of rubber hanging over the market and pressing prices down. But prices didn't skid, indicating that there was no actual surplus even with two big companies out of the market.

The Natural Rubber Bureau estimates that natural rubber production this year will be no better than 1,690,000 tons instead of the 1,705,000 tons at which it was placed 4 months ago. World consumption now is at least as much as the curtailed output. And, of course, if anything happens to curtail production in southeast Asia, the figures will be thrown further out of balance.

Primer Ready for Pump

A new full-employment program has been developed by progressive elements in the Democratic Party and will be proposed in legislative form next year if the Democrats recapture control of Congress.

Basically the plan would involve the old depression era philosophy of sustaining prosperity through Government spending, but supporters of the plan believe that a gradual increase in the national debt would not be harmful in an economy in which every worker had a job.

Under the program the Council of Economic Advisers each January would estimate how many people were likely to be unemployed during the year and how much the Government should spend, over and above the expenditures by industry, to put them to work.

It would call for a complete reversal of the present administration policy of supporting private enterprise. Instead of getting the Government out of business, as this administration aims to do, it would put the federal agencies into all sorts of industry in direct competition with tax-paying private capital.

The new proposals for full employment closely resemble the ideas put forth a decade ago when it was feared the end of World War II would be followed by great unemployment and a new depression.

In the past 10 years, however, great strides have been made toward increasing worker productivity, and that points up a problem which the original program did not solve and which is not solved today—where to market the increased output.

been set at $15 an acre, but bids are expected to range up to two and one-half or three times that amount.

Bids to be opened October 13 will be for oil and gas leases on approximately 748,000 acres and sulfur rights on more than 500,000 acres.

Leases on federal lands off the coast of Texas will be offered in November, but initial return from those areas is expected to total considerably less than bids on lands off Louisiana.

Gas Price in High Court

WASHINGTON.—The Supreme Court was asked last week to determine whether an Oklahoma order fixing prices for natural gas can properly be applied on sales of Oklahoma gas from processing plants in Texas.

Involved is an Oklahoma Corporation Commission order of July 1952, increasing the minimum price on natural gas sold at the well head from 7 to 9.8262 cents per M.c.f.

The order was held valid by the Oklahoma Supreme Court April 27 and a rehearing was refused July 13 in a test case brought by Panhandle Eastern Pipe Line Co., Michigan-Wisconsin Pipe Line Co. and the Natural Gas Pipe Line Co. of America. The three companies last week petitioned the Supreme Court to review the decision.

Panhandle and Michigan - Wisconsin are buyers of gas from the Phillips processing plant in Hansford County, Texas. Natural Gas Pipe Line takes residue gas from a Texas plant of the Panoma Corp. Both plants get natural gas from Oklahoma as well as Texas and the companies challenge Oklahoma's alleged exercise of extra-territorial jurisdiction which they contend is in violation of the commerce clause of the Constitution.

"Cartel" Lawyer Quits Job

WASHINGTON.—Leonard J. Emmerglick, special assistant to the Attorney General and mainspring of the oil "cartel" suit now pending in New York, will leave the Justice Department September 24 to become a law professor at Georgetown University.

Emmerglick will continue as a consultant to the antitrust division, in connection with the cartel case.

The case charges a group of major oil companies with monopoly and restraint of trade in production, refining and distribution outside the United States.

The oil suit is one of a number of major cases in which Emmerglick played a leading role during his 10 years as chief trial attorney.

Producers Back Pipeline

WASHINGTON. — Eight independent natural-gas producers in Big Horn County, Wyoming, have informed the Federal Power Commisison they will supply Montana-Dakota Utilities Co.'s natural-gas pipeline facilities in Montana and Wyoming.

Making applications to supply the gas were eight producers who jointly own a natural-gasoline plant at Manderson, Wyo. Residual gas from the plant would be sold to the pipeline company. The producers are Mobil Producing Co., Gulf Oil Corp., Mule Creek Oil Co., Roy E. Rooth, Sohio Petroleum Co., G. & N. Oil Co., Shannon Oil Co., and Stanolind Oil & Gas Co.

Boundary Holds Up Opening

WASHINGTON. — Questions concerning the boundary lines of Naval Petroleum Reserve No. 4 are the last remaining barrier to the opening of more than 20,000,000 acres of reserved north Alaska lands.

The big reservation runs across the northern end of the territory and surrounds the petroleum reserve on three sides. It is due to be opened to oil and gas exploration and other development in the near future, making possible the proposed pipeline from Gubik gas field to Fraibanks and Anchorage.

The Navy has voiced no objection since its $80,000,000 oil exploration program to test northern Alaska was closed out last year. The naval reserve will be retained by the Government.

It is anticipated that the revocation order will open the area for all purposes, including homesteading, but it is doubtful any homestead applications will be filed.

Jarman Asks GSA Probe

WASHINGTON.—The House small business committee has been asked to take a hand in the running fight between Rep. John Jarman of Oklahoma and General Service Administrator Edmund F. Mansure over the exemption of oil from the Buy American Act.

Advising Mansure that he had laid the matter before the committee, Jarman demanded last week that the GSA submit the "specific background evidence" on which the controversial directive was issued last April 5 by the Dallas office.

Jarman again challenged GSA finding that "crude petroleum is not produced in the United States in sufficient and reasonably available commercial quantities" to enable the agency to buy products of all-American origin.

Ship Cases Dropped

Casey charges dismissed; Morris lawsuits settled

WASHINGTON.—Indictments charging former Rep. Joseph E. Casey of Massachusetts and four associates with violating shipping laws to acquire surplus Government tankers were dismissed by the District of Columbia federal court.

At the same time the Department of Justice announced it had dropped a suit to recover four surplus tankers from shipping interests headed by Newbold Morris of New York, who once served briefly as top corruption hunter for the Truman administration.

The cases against Casey were dismissed under a rarely used immunity clause in the Shipping Act of 1916 designed to protect persons who testify on alleged Shipping Act violations. Casey and his associates testified before a grand jury. Three others named in the indictments remain to be tried, however, if the Government decides to go ahead with its bob-tailed case.

The illegal tanker transactions developed several years ago in a congressional investigation. The Government suit which followed was originally much broader but eight other persons and four corporations settled their civil and criminal differences with the Government by agreeing to pay $110,000 in fines, return 19 vessels and pay $4,000,000 to the Government for use of the ships.

The suits dropped by the Justice Department last week involved T-2 tankers purchased from the Maritime Commission in 1947 and 1948 by affiliates of the United Tanker Corp. which were financed almost entirely by Chinese investors.

Attorney General Herbert Brownell, Jr., said the cases were settled under an agreement which will give the Government $2,025,000 from the sale of one vessel, out of which it will pay about $500,000 for expenses incurred while four other vessels were in the custody of the courts.

The four vessels will be retained by the Morris interests under the condition that American citizen control is guaranteed under department supervision.

The cases were similar in many respects to the civil litigation with Stavros Niarchos interests, which were settled last May. That settlement involved 20 vessels, and resulted in payment to the Government of $4,000,000, forfeiture of the vessels to the United States and discharge of Niarchos interests of approximately $6,000,000 of mortgage liens.

New Catalytic Processes

A.C.S. symposium reveals some of new techniques being developed for making and improving existing gasolines

George H. Weber

NEW YORK.—New light on reactions involved in some well-known catalytic reforming processes, and some new catalytic techniques for upgrading motor fuel were revealed by a day-long symposium at the American Chemical Society's annual meeting here last week.

One of the new processes is selective hydrotreating, reported by a five-man team from Shell Oil Co.'s Houston Manufacturing-Research labs. This mild hydrogenation of gasoline employs a tungsten nickel sulfide catalyst and can utilize net hydrogen produced by catalytic reforming. Under properly controlled conditions, it successfully converts sulfur compounds to removable hydrogen sulfide, and reduces diolefins which form gum in storage. At the same time, the hydrogenation of monoolefins is held to a relative low level so that clear octane is not sacrificed by downgrading those cracked components. The improved lead susceptibility of the sweetened gasoline more than offsets the loss in clear octane.

The authors reported pilot plant results from treating several types of cracked gasolines, and revealed reaction studies with mixtures of pure compounds. These tests showed that the presence of sulfur tends to inhibit olefin saturation. In the absence of olefins sulfur compounds appear to hydrogenate slightly faster at the lower space velocities. In all experiments, mercaptan sulfur was completely reacted to H_2S while thiophenic sulfur remained unreacted.

BF_3 process . . . H. Buether and R. G. Goldthwait of Gulf Research & Development Co. reported on the use of boron trifluoride for treating unstable cracked gasolines. This gaseous polymerization catalyst is highly soluble in gasoline and is not corrosive to most materials unless appreciable quantities of water are present.

The process has no appreciable effect on clear or leaded octane, but improves gasoline stability and engine cleanliness characteristics. Contacting is carried out in a simple reactor at room temperature and atmospheric pressure, followed by settling of sludge, water washing of BF_3 and redistilling for soluble polymer removal. Yield losses from BF_3 treating and rerunning are about 5 to 7 per cent compared to 5 per cent losses by rerunning untreated gasolines to the same end point.

The process, using 0.1 per cent BF_3 is commercially competitive with such conventional methods as caustic treating, sulfuric acid treating and vapor phase clay treating, the authors said. Its advantage, they concluded, lies in its extreme simplicity, lack of corrosiveness and effectiveness in treating. Limited investigations of sludge recycle showed that a particular gasoline produced from recycle treating with addition of 0.05 per cent fresh BF_3 was equally stable as gasoline treated with 0.1 per cent single-pass treating. This proves that the sludge product is an active treating agent but does not guarantee similar results in treating all gasolines while recycling of an equilibrium sludge.

Reforming reactions . . . Reports were made on the continuing investigations into the complex reactions involved in catalytic reforming. A Universal Oil Products Co. team discussed the dehydrocyclization reactions which occur in the Platforming process. The authors investigated the conversion of paraffins to ring compounds and subsequently to aromatics, which was believed to take place in commercial Platforming operations.

A mixture of C_8-C_{11} normal paraffins was Platformed to show the effect of various operating conditions on product distribution. The results verified the belief. Aromatic production by dehydrocyclization of the normal paraffins proceeds readily, said the authors. It is promoted by higher temperatures, lower pressures and lower space velocities. The aromatics which were produced followed a distribution pattern agreeing with equilibrium data.

The same approach was employed in a Sinclair Research Laboratories project studying the reactions obtained in using the Sinclair-Baker RD-150 platinum catalyst. Two pure compounds were used as feed stocks: n-heptane and methylcyclohexane. Dehydrogenation of the latter feed was rapid with reaction rate quite sensitive to catalyst particle size. Paraffin isomerization, although not as rapid, was readily accomplished. They also found that dehydrocyclization proceeded better at higher temperatures and lower pressures.

Reforming hydrocracked gasolines . . . A revived interest in research on the hydrocracking of heavy fuels has prompted Houdry Process Corp. to investigate the upgrading of hydrocracked gasolines by the Houdriforming process. A paper on this subject reported on the types of compounds produced by hydrocracking.

They found that gasoline obtained from the hydrocracking of a heavy gas oil, strongly resembles the straightrun gasoline obtained from the same crude, in both composition and reforming characteristics. The advent of catalytic reforming has provided a new supply of low-cost hydrogen which might be used to supply part of the hydrogen needs for high-pressure hydrocracking of heavy crude fractions. The authors cited previous work which showed that 80 to 100 per cent of relatively low octane gasoline can be obtained from crude by distillation and hydrocracking. The Houdriforming of this fraction, they concluded, could result in a 72 to 90 per cent yield of gasoline based on crude, which would show an F-1 clear octane number of 85 or better.

Evaporation Loss Curbed

NEW YORK.—A new approach to controlling evaporation losses of gasoline and other light oil products was presented last week at the annual American Chemical Society meeting in New York. Certain fluorocarbons when mixed with gasoline have been found to form a molecular film on the liquid surface, halting evaporation.

In one example, three thousandths of one per cent of a particular fluorocarbon was added to one gasoline sample, exposed to the same conditions as an equal untreated sample of the same gasoline. After the untreated sample was completely evaporated, 75 per cent of the treated sample remained in the open vessel.

According to their manufacturers, Minnesota Mining & Manufacturing Co., these fluorocarbon surface active agents have no effect on octane or other gasoline qualities. The additives have other potential uses. Almost twice the normal kill of houseflies resulted from addition of the surfactant to a standard fuel oil base insecticide.

Program Completed

Secondary recovery talks to highlight conference

STATE COLLEGE, Pa.—New developments in secondary recovery will be stressed in papers presented at the eighteenth conference on petroleum production, to be held at Pennsylvania State University October 6-8.

The conference will be sponsored by the College of Mineral Industries. Authors and titles of papers to be presented are listed below.

October 6—"Progress in Electric Logging Research at the Pennsylvania State University During 1953-54," E. James Moore, of the university staff; "Some Factors Related to the Measurement of the Electrical Properties of Porous Sandstones," C. R. Holmes, Penn State; "Definition of an Oil Sand by Quantitative Petrographic Analysis," J. R. Emery and J. C. Griffiths, Penn State; "Further Tests of Dimensional Orientation and Directional Permeability," J. Hutta and J. C. Griffiths, Penn State.

October 7—"Recent Developments in Treating Water for Subsurface Injection," T. M. Doscher and R. N. Tuttle, Shell Development Co., Houston; "The Inhibition of Gypsum Precipitation by Sodium Polyphosphates," F. J. Burcik, Penn State; "Use of Radioactive Tracers in a Study of Displacement in a Model Five-Spot System," R. E. Wainerdi and R. F. Nielsen, Penn State; "Interrelationship Between Oil and Gas Relative Permeabilities," A. T. Corey, Gulf Research & Development Co., Pittsburgh; "On the Behavior of Linear Floods," J. Jones-Parra and J. C. Calhoun, Penn State; "The Inlet Saturation Distribution Transient in a Water Flood," J. E. Warren, C. L. Stockwell, and J. C. Calhoun, Penn State.

October 8—"Variables Affecting Recovery of Nonwetting Fluids," J. G. Paez and J. C. Calhoun, Penn State; "Determination of Effective Formation Permeabilities and Operational Efficiencies of Water-Input Wells," J. C. Joers and R. V. Smith, U. S. Bureau of Mines, Bartlesville, Okla.; "New Concepts in Reservoir Heat Engineering," R. Jenkins and J. Aronofsky, Magnolia Research Co., Dallas; "A Study of the Three-Phase Equilibria for Carbon Dioxide-Hydrocarbon Mixtures," A. H. Meldrum and R. F. Nielsen, Penn State.

A.G.A. to Hear Adams

ATLANTIC City.—E. H. Eacker, president of the American Gas Association, will discuss present ailments of the gas industry and outlook for the future at the association's annual convention in Atlantic City October 11-13. Eacker is president of Boston Consolidated Gas Co.

Effects of the recent Supreme Court decision against Phillips Petroleum Co. will be discussed by K. S. Adams, chairman of the board of Phillips.

Other speakers will include Dr. Kenneth McFarland, General Motors Corp.; Sheldon Coleman, Coleman Co., Inc., president of Gas Appliance Manufacturers Association; J. Theodore Wolfe, Consolidated Gas Electric Light & Power Co.; John J. McCloy, Chase National Bank; and D. A. Hulcy, Lone Star Gas Co.

A.I.E.E. Program Set

TULSA.—The first electrical conference of the petroleum industry, to be held in Tulsa, September 27-29, will provide an interchange of ideas in electrical technology for all phases of the oil industry.

Sponsored by the petroleum committee of American Institute of Electrical Engineers, the conference will include sessions on refining, pipelining, and drilling and production.

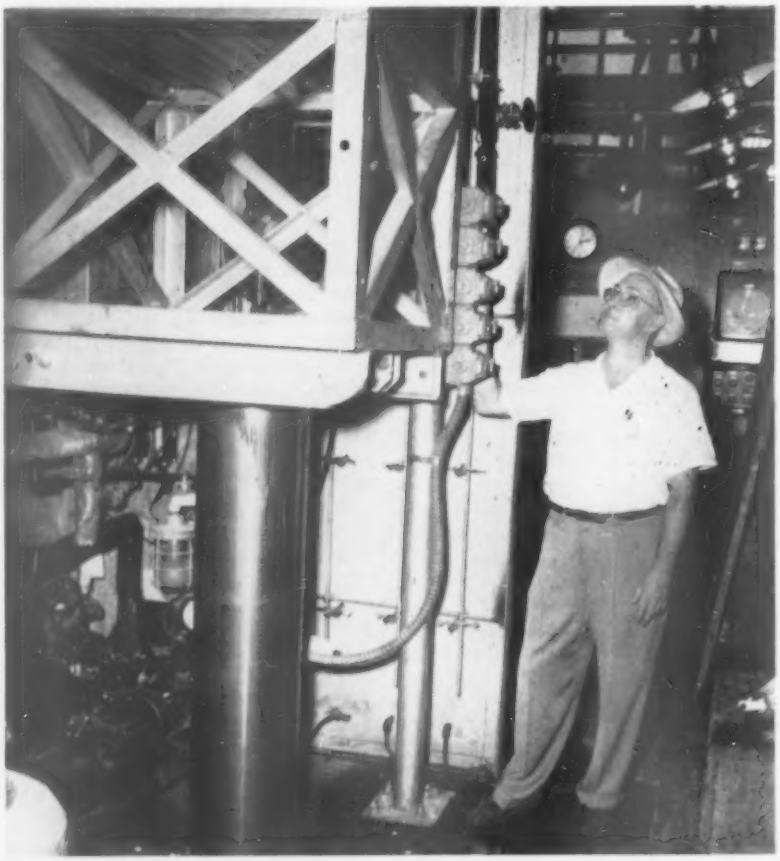
The refinery session will feature discussions of power systems, lightning protection, and training of personnel.

Automatic pump stations, uses of radioactive substances in the petroleum industry, and other topics will be covered in papers presented at the second session, which will be devoted primarily to pipelining.

The third session will cover use of electricity in drilling, pumping, and water flooding.

Pipeline Program Slated

HOUSTON. — The committee on pipelines of American Society of Civil Engineers will sponsor a special pipeline program in connection with the society's annual convention in New York City October 21.



Grease Rack Solves Research Problem

A hydraulic hoist similar to that used at service stations to lift cars for grease jobs has been installed at the Baton Rouge Esso Laboratories to give oil researchers a lift in their job. Faced with the problem of keeping part of their heavy equipment at temperatures above 1,000° F., research engineers surrounded the equipment with a heavy kiln. But the kiln was too heavy to be removed easily as was essential to the operation. By use of the hydraulic hoist, it now may be raised or lowered with the flick of a switch. Shown inspecting the apparatus is F. W. Wolfe, Baton Rouge.

Maj. Gen. S. D. Sturgis, Jr., chief of engineers for the U. S. Army, will discuss pipelines and the national defense, and Charles J. Hodge, partner in the firm of Glore Forgan & Co., New York, will present a paper on pipeline financing.

Other speakers will include Steve D. Bechtel, Jr., manager, pipeline division, Bechtel Corp., and William B. Poor, pipeline construction manager, Ford, Bacon & Davis, Inc.

"Robots" to be Discussed

NEW ORLEANS.—Automatic operation of pipeline stations, growth of the petrochemical industry, and artificial forces in oil production will be among the topics discussed at the twenty-sixth annual conference of the Petroleum Electric Power Association in New Orleans October 4-6.

Papers on these subjects will be presented, respectively, by C. S. Williams, The Texas Pipe Line Co., Houston; J. P. Warner, Esso Standard Oil Co., Baton Rouge; and Darrell Chandler, Sun Oil Co., Beaumont.

Other speakers will include J. E. Moody, association president; W. Q. Turner, Louisiana Power & Light Co., New Orleans; E. L. Robinson, Gulf States Utilities Co., Beaumont; J. B. Land, General Electric Co., Schenectady, N. Y.; Rex N. Brown, Southwestern Public Service Co., Amarillo, Tex.; C. R. Bayless, Gulf Oil Corp., Houston; E. A. Armstrong, General Motors Corp., LaGrange, Ill.; L. U. Eidson, Westinghouse Electric Corp., Houston; and H. E. Mortimer, Gulf States Utilities Co., Beaumont.

GULF COAST

Stanotex Finds Gas

HOUSTON. — A third natural-gas zone has been hit in the Gulf of Mexico off Padre Island by a second Standard Oil Co. of Texas well drilled from an offshore platform.

The second well, being drilled directionally as an offset to the discovery well, tapped a gas show from 7,843-49 ft., which is below the oil section in the discovery well. Two other gas sections have been found in the second well. Stanotex made the first commercial discovery in the Texas tidelands several weeks ago *(The Oil and Gas Journal, July 5, page 102)*.

The well will not be completed as a gasser, however. Stanotex has revealed plans to lay a crude pipeline from the shore of Kleberg County out to the drilling platform, about 1½ miles from Padre Island.

Pilot Injection Started

DALLAS.—Magnolia Petroleum Co. started injecting gas last week through a second 1-well pilot into the Anona chalk formation underlying its Doan Thigthan lease in Pine Island field, North Louisiana.

The company is already injecting about 150 bbl. of water daily at roughly 100 psi. in a similar 1-well pilot.

The company received a permit from the Louisiana Conservation Commission during the summer to conduct the projects, stirring up considerable interest in the industry since the Anona chalk is a hard, tight formation generally considered to be unsuitable for conventional secondary-recovery operations.

The chalk in this area is encountered at 1,500 to 1,600 ft. and is about 150 ft. thick. Tightness of the formation is illustrated by the fact that Magnolia recently drilled some new wells on 5-acre spacing in an old producing area in the chalk and brought them in flowing.

Louisiana May Protest

BATON ROUGE.—Fred S. LeBlanc, Louisiana's attorney general, may file a protest against the Interior Department's plans to lease 199 tracts off the Louisiana coast.

LeBlanc said he is examining the 748,000 acres included in the tracts to determine whether to file a complaint. Louisiana and the department have conflicted over the tidelands, with both claiming jurisdiction in the area outside the 3-mile area *(The Oil and Gas Journal, August 16, page 105)*.

Bonus bids on the tracts will be opened October 13 *(The Oil and Gas Journal, September 13, page 96)*.

Billion-Dollar Fund Predicted

CORPUS CHRISTI.—Bascom Giles, state land commissioner, predicted last week Texas' public school fund will grow to "a billion dollars within my lifetime" as result of the state's offshore oil play.

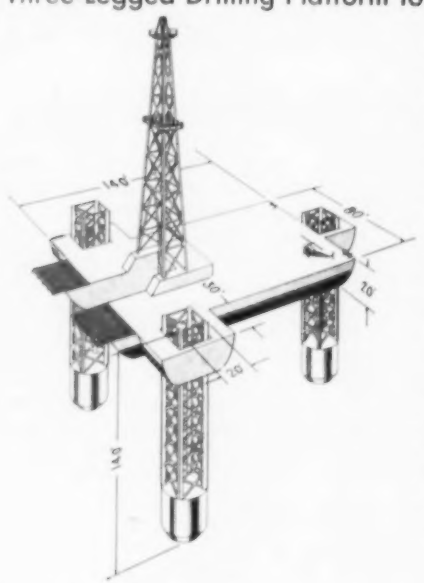
Giles said Texas has received $40,000,000 from leasing only 20 per cent of the state's 3,250,000 acres of offshore land. He said present tidelands production royalties net the state more than $4,000 monthly, adding that he is confident this figure will be multiplied 100 times within the next few years.

Giles was visiting Gulf Oil Corp.'s wildcat off Mustang Island in Tract L-174 when he made his prediction. The Gulf well is drilling below 11,788 ft. in 65 ft. of water.

Silicone Authors

In the article "Silicones—New Tools for Petroleum Operations," which appeared in The Oil and Gas Journal, September 13, page 118, the authors were erroneously listed as being with Dow-Corning Corp. The correct company affiliations are: Jock Oliver, with Kansas Paint & Color Co., and Max Leavenworth with Dow-Corning Corp.

Three-Legged Drilling Platform to be Built for Zapata



Zapata Petroleum Corp. has taken an option to purchase a mobile offshore drilling platform such as that shown in the accompanying sketch for oil exploration in the Gulf of Mexico. The floating platform will be built by R. G. LeTourneau, Inc., of Longview, Tex., at its Vicksburg, Miss., plant. Construction is scheduled to start within 60 days. After it is built and tested, it will be floated down the Mississippi River to the gulf. The legs, or spuds, will be electromechanically control'ed so they may be easily raised or lowered. They will project above the barge-like platform when it is being moved and will be planted on the ocean floor to support the structure during drilling operations. After the spuds are lowered to the ocean f oor, motors will elevate the platform to a desired height above the waves. The platform is designed for elevation up to 100 ft. above the bottom of the ocean. Any of the spuds may be raised or lowered as necessary to keep the platform level.

ROCKY MOUNTAIN

Gas Line Hearing Delayed

BISMARCK, N. D. — The Public Service Commission has granted a request of North Dakota Natural Gas Transmission Co. for postponement of a rehearing on the company's Tioga to Fargo natural gas pipeline application.

The rehearing, scheduled September 14, has been reset for November 16.

Elmer W. Cart, commission president, said North Dakota Natural was unable to meet the September hearing date mainly because Amerada Petroleum Corp., which has contracted to furnish gas to the pipeline company, is reluctant to enter interstate commerce. In its application for rehearing North Dakota Natural said it was negotiating with Montana-Dakota Utilities Co. for storing off-peak gas in MDU's eastern Montana underground storage fields.

Western Line Started

FORT LARAMIE, Wyo.—Construction started in several locations last week on Western Pipe Line Co.'s 628-mile big-inch crude line between here and Freeman, Mo.

Construction headquarters for the eastern section has been established at Abilene, Kans., with H. G. Mariner, Raytown, Mo., manager of Service's Missouri division, in charge. H. C. Jones, Topeka, Kans., manager of Service's Nebraska division, will be in charge of the western headquarters at Sterling, Colo.

The common carrier is scheduled for completion this year *(The Oil and Gas Journal, August 23, page 107)*.

Shell Plans Crude Line

GLENDIVE, Mont. — Shell Pipe Line Corp. will build a 35-mile, 12-in. crude pipeline from Cabin Creek field to a Northern Pacific Railroad loading rack that will be constructed near here.

The line will handle production from both Cabin Creek and Pine Unit fields. It will be designed to handle present production from these two fields with reserve capacity for possible future expansion and development of the area. The Cabin Creek-Pine Unit crude currently is moved to Glendive by tank wagon.

A Shell spokesman said construction will begin immediately. The line is scheduled for completion by November 15. Anderson Brothers Corp., Houston, has been awarded the contract.

Polaroid Camera Provides . . .

. . . Air View of Pipeline Leaks

AIRBORNE cameras which print their own pictures are providing visual evidence to help landbound crews find pipeline leaks.

Polaroid Land cameras mounted in patrol planes spot leaks. Within a few seconds they produce a picture of the trouble scene, showing an easily recognized landmark, and the patrol pilot drops the picture at the nearest pump station. Land crews take over there and quickly repair the leaks.

Photographic reconnaissance of pipelines, although a relatively new development, has been used for about 3 years by F. C. Barr Pipe Line Patrol, of Corpus Christi. Barr, himself a retired pipeliner, started inspecting his own lines by air in the '30s. During the last 10 years he has been flying for other pipelines on a contract basis. Now 70 years old, he still flies for such clients as Sun Pipe Line Co. He has a fleet of nine planes "walking" pipelines.

Barr pilots have spotted many emergency situations from the air, but some of the emergencies have nothing to do with pipeline leaks. Larry Delavan (pictured cocking his camera for action) once detected a burning house before the occupants knew it was on fire. By circling persistently above the house, he attracted their attention to the blaze. With today's equipment, he could have given them a picture of it.

LOADING the first tanker at the Muturi terminal.

It's a tough, costly operation, but . . .

. . . New Guinea Search Continues

Dahl M. Duff

A GROUP of major oil companies is pushing ahead with a costly exploration program in the jungles of western New Guinea, where three relatively small producing areas have thus far been discovered.

The operating company is Nederlandsche Nieuw Guniee Petroleum Mij. (N.N.G.P.M.) in which N. V. De Bataafsche Petroleum Mij. (Royal Dutch-Shell) holds 40 per cent, Standard-Vacuum Oil Co. another 40 per cent, and Far Pacific Investments, Inc. (Caltex) the remaining 20 per cent. B. P. M. is in charge of management.

From late 1948 until a few months ago, N.N.G.P.M. produced around 4,700 bbl. daily of heavy, asphaltic 18.9°-gravity crude from a single field, Klamono. The middle of this year, 51 miles of pipe line were completed to bring the other two fields, Wasian and Mogoi, on production *(The Oil and Gas Journal, June 7, page 83).*

The program in western, or Netherlands, New Guinea dates back to the late 1930's and has so far cost the participating companies the equivalent of more than $110,000,000. Exploration in the Vogelkop, the bird's-head peninsula comprising the western part of the territory is nearing completion, but several years will be required to drill prospective areas that have been located.

Current activity . . . In the near future, exploration wells will be drilled at Klamunuk and near Klamono. Drilling is already under way at West Klamono with an Ideal 50 rig, at Sele with an Ideal T 20, and two rigs of the type Brewster N 2 are being assembled at Beraur and Djagiro.

Geological surveys are at present being made at Waropen, South Bomberai, Arguni, Etna and Geelvink Bay. Gravity meter parties are operating at Tarera, Southeast Bomberai, and Waropen, while a combined seismic unit with the aid of helicopters is working at South Bomberai.

These operations represent a continuation of the 1953 level of geological and geophysical activity when three geological, three gravity meter, and two seismic parties were in the field throughout the year. Last year, the company completed only one wildcat, a dry hole drilled to 8,737 ft. at Klamogun. Helicopters as an aid to seismic exploration were first used by N.N.G.P.M. in 1952 and were found to be practical and economic.

Background . . . The original concession was granted to the company in 1935 and covered an area of 24,710,000 acres or around 38,500 sq. miles out of a total area in all Western New Guinea of 153,350 sq. miles. It included the southern half of the Vogelkop and extended on down the southern coast. Under terms of the concession, the company may retain one-tenth of the original area for development, and this reduction must take place at the latest by January 1, 1966.

As an initial step in its program, N.N.G.P.M. before the war undertook one of the first large-scale aerial mapping projects in the industry, and in about a year's time the concession was

almost completely covered. Klamono field in the western part of the Vogelkop was discovered in 1936, and the other two fields, Wasian and Mogoi 4 years later.

All these areas produce from the same formation which is known as the Klasafet limestone of Miocene age. The structures are anticlinal. Wasian produces a 48°-gravity paraffinic crude 2,900-3,225 ft., and Mogoi, a 46°-gravity paraffinic oil from around 1,250 ft. The gravity of these two crudes is considerably better than the 18.9° oil from Klamono.

Problems involved . . . The physical difficulties of operating in this country are immense. Large sections are covered with swamp and vine-tangled jungle.

At the time the program commenced, Netherlands New Guinea was considered the world's largest unexplored and unmapped area. About the only means of access to the interior was by the navigable rivers. At each location, trees were cut and the stumps dynamited. Unless buildings were on concrete bases, they were usually demolished in a few months by termites. At Sorong, as much as 10 ft. of rain has been recorded in a single month.

Despite these problems, by the time World War II spread to this part of the world, the company had drilled 14 producing wells, including 8 at Klamono. Before the Japanese invaded the territory, a thorough program of destruction was carried out by the operators. Workers were evacuated, and equipment which could not be moved out was destroyed or dumped in the river.

Operations were commenced afresh in 1946. A base and port were established at Sorong where company headquarters are located, and a 30-mile road to Klamono undertaken. The road, encountering jungle, incessant rain, and heavy clay soil, was finished 2 years later at a cost equivalent to around $60,000 a mile. A parallel 8-in. pipe line was laid, and Klamono brought into production. Early operations in the field were facilitated by the fact that it produces from around 300 ft. and only light equipment was required.

The other two fields are situated in the southeastern part of the Vogelkop. At Wasian, drilling is being carried out with one rig, alternately an Ideal T 20 or Cardwell R. The total number of wells drilled (to June 1) amounts to 13. Well spacing is about 1,300 ft. Forty-five wells have been drilled in Mogoi with a single rig of the type Woodfield W-4-S, the well spacing varying between 800 and 1,300 ft. There are no particular drilling or completion problems except that large mud losses are frequent, owing to the limestone formations. The wells are acidized before going on production.

Crude movement . . . The new outlet for these fields is the Muturi terminal, on the mouth of the Muturi River which flows into Bintuni and McCluer gulfs.

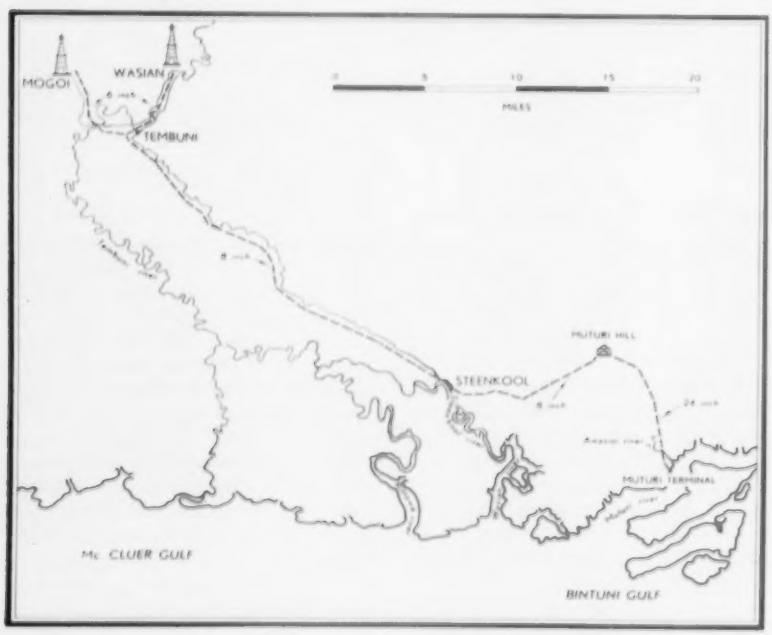
The production from Wasian and Mogoi is carried from the wells to test stations, and after settling there, it is pumped without further treating via 6-in. lines over a total distance of 11 miles to the gathering station at Tembuni.

At Tembuni, two storage tanks have been erected, each with a capacity of 19,000 bbl. Two pumps, each with a 315 bbl. per hour capacity move the oil from these tanks through an 8-in. line over a distance of 31 miles and with a difference in height of 300 ft. to the Muturi tank farm. Here there is a 138,000-bbl. tank, and a second of the same size is under construction. For the greater part of its route, the line is laid along the existing road from Tembuni to Steenkool.

From the Muturi tank farm to the terminal, the loading line is laid through marshland on a trestle of concrete piles. A major construction problem in this phase of the project was the heavy rainfall which often caused landslides. No storage is provided at the Muturi terminal itself, and tankers are loaded by gravity through a 9-mile 24-in. line which extends from the tank farm.

The construction of the entire pipe line took about 2 years, and was completed within the scheduled time. Cost amounted to about $6,500,000. The project was carried out by Dutch contractors and required the services of about 160 skilled Dutch workmen and around 1,000 Papuan laborers.

Wasian and Mogoi together now produce about 9,000 bbl. daily. Drilling results at Wasian have been generally disappointing, and neither field is large. It is hoped, however, to develop other fields which can be connected into the new pipe line.



ROUTE of the new Muturi pipeline.

Douglas Hits Again in Peru

A second producer on the northwest coast of Peru has been completed by Douglas Oil Co. of California.

The latest test flowed at the rate of 90 bbl. of 38°-gravity oil daily through ¼-in. choke, W. G. Krieger, company president, reported. The well, a directional hole drilled from shore, was bottomed 1,200 ft. offshore at a depth of 3,266 ft. It is about 2 miles northwest of the first Douglas producer, a 30-bbl. well completed last June.

Continuing its exploration program on the coastal side of the Lobitos area, the company is rigging up for another test, a 5,000-ft. well ½-mile northwest of the second discovery.

Argentine Deal Revised

Strong state-control sentiment forces Odlum to submit new three-point oil development proposal to government

SOME extensive revisions have given new life to Floyd Odlum's proposed oil-development deal with the Argentine Government.

The revisions were made by Odlum under the pressure of still-strong state-control sentiment in Argentina. His earlier offer was made last June, and since then the deal had been reported as virtually dead.

Odlum, president of the Atlas Corp., a United States investment company, said in Buenos Aires last week the new proposal involves a three-part undertaking to (1) build the Neuquen-Bahia Blanca pipeline; (2) survey the country's uranium-thorium resources; and (3) take over blocked Argentine pesos belonging to American investors.

One feature of the earlier Odlum proposal which has been eliminated was that calling for an interest in production from existing wells in the Neuquen fields *(The Oil and Gas Journal, June 21, page 128)*. The latest offer provides for joint development with the Argentine state company, Yacimientos Petroliferos Fiscales, of the next 300 wells in the area, and by the Odlum interests alone of a further 200 wells. Instead of the 25-year duration for the contract proposed last June, the new Odlum proposal provides for a term of only 15 years. The Argentine company, Petroargentina, to be formed by Odlum and the United States company, Dresser Industries, Dallas, originally proposed to build the 400-mile, 16-in. pipeline and operate it for 25 years before turning it over to the Government. The revised offer calls only for construction of the line. Petroargentina would turn the line over to Argentina after a year's initial operation.

Odlum's new proposal calls for a 9-month survey of uranium and thorium, followed by more intensive exploration for 2 years and then 12 years rights on mining. Twenty-five per cent of the proceeds of sales of these minerals would be set aside for construction of an atomic-energy power plant. The Odlum interests would build the plant within 10 years, regardless of what sum had been accumulated toward its construction.

The amount of block pesos which the Odlum interests would take over amount to the equivalent of about $43,000,000. A management holding corporation would be established in Argentina, and its stock listed on the New York exchange. This company, Atlas Corp. of Argentine, would be capitalized with blocked pesos. Its profits would be remittable at an 8 per cent annual rate with amortization beginning in 10 years. Atlas of Argentina would partially finance both the pipeline and the uranium ventures.

Israeli Exploration Up

Approximately $6,500,000 have been spent on exploratory work in Israel, according to the Israeli minister of finance, Levi Eshkol.

Four rigs are either in operation or about to drill, and geophysical and geological parties are making studies in selected areas from the Negev to Galilee. Since the promulgation of Israel's petroleum law 2 years ago, the government has issued licenses covering more than 2,500,000 acres, or about 50 per cent of the country's total land area *(Further details on the Israel oil play were given in The Oil and Gas Journal, July 26, page 150)*.

Italians Eye Sicily

Six explorations permits issued as interest rises

ITALIAN companies are moving into the exploration play in Sicily in increasing numbers.

Six new exploration permits have been granted recently by the Sicilian Government. One of these, for 19,507 ha., or about 48,000 acres, in the region of San Pietro, was to D'Arcy Exploration Co., Ltd. (Anglo-Iranian). The others were to Italian companies as follows:

Soc. Estticino, Milan, 42,476 ha. (about 105,000 acres) in the region of Piazza Armerina between Enna and Caltanisetta; Soc. A. P. E., Genoa, 37,688 ha. (93,000 acres) in the region of Segesta in the province of Trapani; Soc. Raffinerie Siciliane Olii Minerali, Palermo, 31,080 ha. (76,500 acres) in the region of Mascalussia in the province of Catania; Soc. Emiliana Esercizi Elettrici, Parma, 34,955 ha. (86,000 acres) in the region of Barrafranca in the provinces of Enna, Agrigento, and Caltanisetta; and Soc. Industrie Chimichi Edison, Milan, 42,923 ha. (106,000 acres) in the region of Trapani in the province of Trapani.

The Italian companies undertaking these programs are making plans to order seismograph and drilling equipment in the United States, and are seek-

Kerosine Still Top Product Many Places

In many parts of the world, kerosine ranks as the leading petroleum product. Demand is particularly heavy in underdeveloped regions where it is used extensively for lighting. Here at Accra in the Gold Coast of West Africa a native woman fills her can with kerosine from the distributor's pump (a Socony-Vacuum photo).

ing the services of German geologists and engineers.

Foreigners active . . . Several foreign companies have been active in Sicily for several years, and affiliates of Gulf and Anglo-Iranian have already made heavy oil discoveries.

The island is the only part of Italy where foreign companies are participating in exploratory work. Under its regional autonomy, Sicily has a separate petroleum law which, unlike the Italian law, is favorable to foreign oil capital.

New Caledonia Probe Set

A drilling program calling for four shallow wells is planned by French interests carrying on exploratory operations in New Caledonia in the South Pacific.

The area of immediate interest is at Gouaro, near Bourail, the second largest town in New Caledonia. Four wells of about 2,000 ft. depth are planned.

The operating company is Soc. de Recherche et d'Exploitation de Petrole en Nouvelle Calendonie. Capital is held 65 per cent by the French Government's Bureau de Recherches de Petrole, 15 per cent by the Territory of New Caledonia, and the remaining 20 per cent by private capital. Last year the company obtained traces of oil in fractured serpentine at a depth of 50 to 75 ft. in a well drilled near Koumac in north New Caledonia.

Heavy Sicilian Crude Tested

Further tests and studies are being carried out by D'Arcy Exploration Co., Ltd., to determine if the extremely heavy oil found in its Vittoria, Sicily, well can be commercially produced.

Reports in the industry are that the company obtained crude of around 5° gravity in the Jurassic dolomite in drill-stem tests below 6,500 ft. The well, drilled by the Italian Government organization. Azienda Generale Italiana Petroli, ran into a fishing job and has been bottomed at around 7,000 ft., the depth reached when the test was made. No further drilling is planned.

It may be possible to produce the crude with a diluent. It is semisolid at the surface and would be sold as asphalt. The Vittoria well is about 28 miles west of the Gulf operation at Ragusa where about 600 bbl. daily of 19.8°-gravity crude is being produced from each of two wells in a field discovered early this year. *(The Oil and Gas Journal, July 19, page 85.)*

Pemex Starts Plant

Construction work has begun at Reynosa, Mexico, on a gasoline absorption plant for the Mexican Government oil agency, Petroleos Mexicanos.

The plant, which will have a capacity of about 300,000,000 cu. ft. daily, will go into operation next summer. Mexican authorities hope to begin the large-scale export of gas into the United States after the plant is opened. It is expected that U. S. gas transmisison companies planning to augment their supplies from the northern Mexican fields will be able to obtain necessary permits.

Pemex considers that its natural-gas reserves are much higher than can be used domestically. In the expropriation report last March, gas reserves were given as the equivalent of 635,000,000 bbl. of crude oil. This would place total Mexican gas reserves at approximately 3.8 trillion cubic feet.

New Australia Test Spudded

West Australia Petroleum, Ltd., has spudded in a test of the Cape Range structure near the site of its Rough Range discovery at Exmouth Gulf in western Australia.

The Cape Range anticline is the much larger feature to the northwest of the separate Rough Range structure on which the company obtained Australia's first commercial production last November in the basal Cretaceous at 3,605-20 ft. The light rig used on the unsuccessful No. 2 Rough Range well is drilling the Cape Range test.

The heavier government rig which Wapet bought from the Australian Government was landed recently at Derby.

Oil-from-Coal-Plan Urged

Indian Government told to build 2,000-bbl. per day plant despite $42 million cost; details for construction ordered

DESPITE the tremendous expense involved, the Government of India is continuing to move ahead with plans for the construction of a synthetic oil-from-coal plant.

A committee of technical experts and engineers which was appointed by the government to study the project has recommended the construction. Dr. N. Lahiri, director of the Fuel Research Institute at Dhanbad, was appointed to work out details.

The synthetic-oil plant is another step in the country's quest for self-sufficiency in oil and relief from imported supplies. India's only indigenous production consists of about 7,000 bbl. daily from Digboi field and the new Nahorkatiya area in Assam by Assam Oil Co., Ltd. India this year will consume about 89,000 bbl. daily, including bunkers.

The Indian Government also has reorganized its own oil exploration branch. The deputy minister for natural resources and scientific research, K. D. Malaviya, said recently in New Delhi that a new division would be set up in the ministry before the end of the year to carry out exploratory work, including drilling. At present, exploration for the Government is done by two bodies, the Geological Survey of India and the Indian Bureau of Mines.

Cost, background . . . Recent estimates indicate the synthetic-oil plant would cost the government 20 crores of rupees, or about $42,000,000. This is for a plant producing 100,000 tons, or around 2,000 bbl. daily. However, it is felt that the high cost would be partially offset by the value of the chemical production.

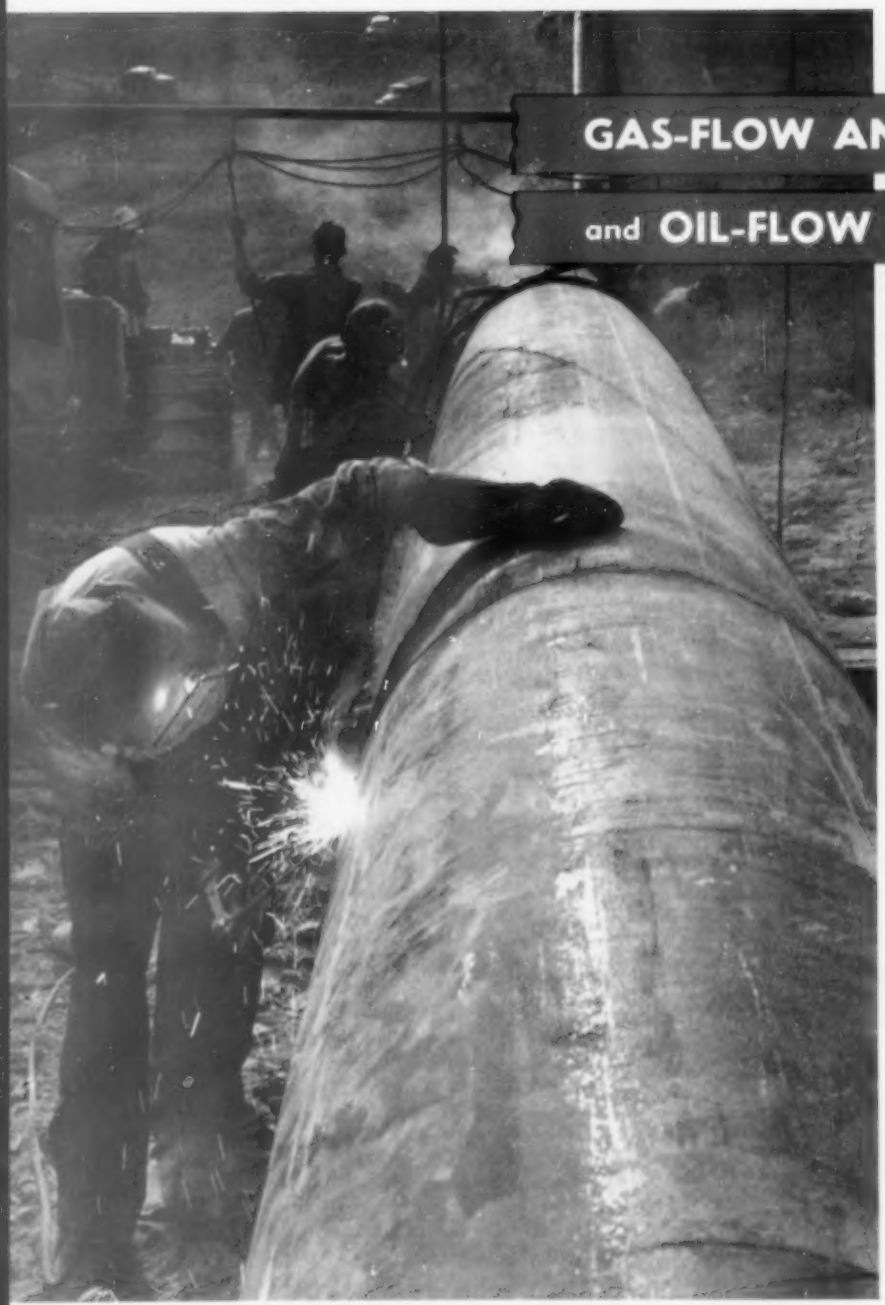
The plan for a synthetic-oil plant was considered by the Indian Government as early as 1948. Koppers, Inc., as consultant to the government, suggested the establishment of a plant for the manufacture of 150,000 tons of different petroleum products using 1,700,000 tons of noncoking coal from the Damodar Valley area.

Later, Koppers submitted a modified project for a plant to produce aviation fuel, motor fuel, and refined phenols as well as domestic coke. Another proposal was from Lurgi Gesselschaft, a German firm, which submitted a plan for the use of a modified Fischer-Tropsch process.

The project at that time was shelved on account of the large financial outlay. It was revived last year as government officials gave increasing recognition to the strategic importance of a domestic petroleum supply.

The Union of South Africa has a synthetic-oil plant under construction south of Johannesburg. This government-financed undertaking is designed to product about 4,300 bbl. daily of gasoline along with chemical products. It will cost around $92,000,000.

Pipelining in '54



GAS-FLOW ANALYZER—with insert

and **OIL-FLOW ANALYZER**

• Construction

Trends in pipeline construction are summarized in this section. A new high-pressure air-testing method has been developed for a natural-gas trunk line. The advances in radiographic techniques are leading to greater effectiveness in welding inspection. Current pipe-laying practices are reported from major projects being built this year.

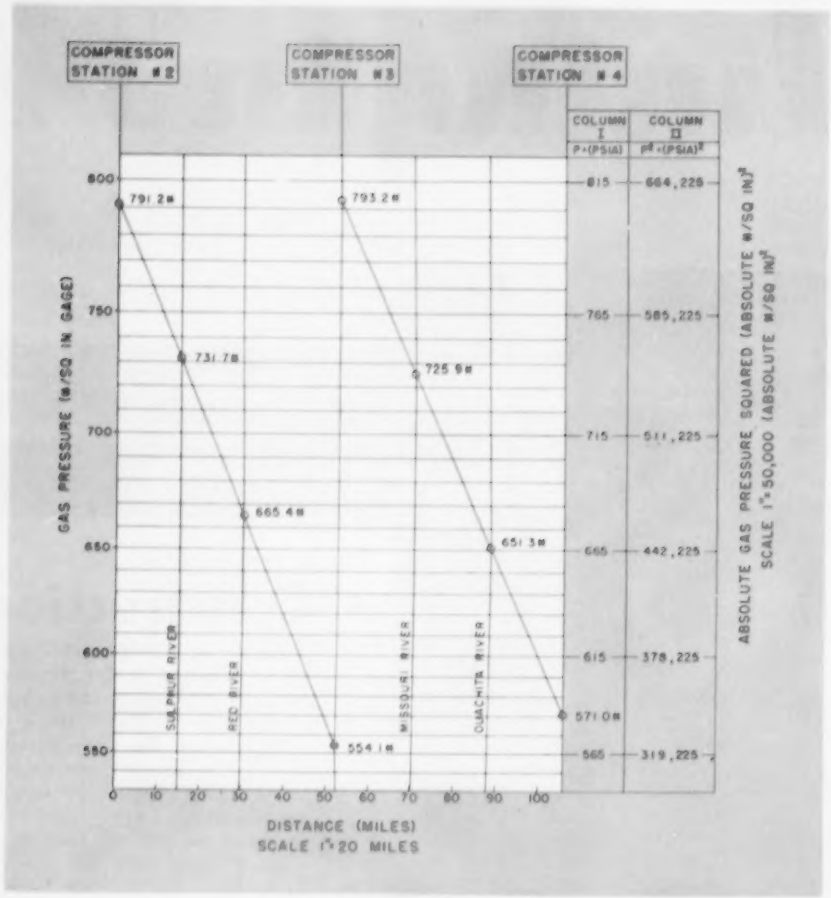
• Operation

Here are nine know-how-packed articles. They're written by well-known authorities in the operating end of oil and gas-pipeline companies and are jammed with pertinent information. Articles range from a report on supercharging of horizontal gas engines to microwave-system maintenance practices.

• Controls

We've gathered several articles based on this fastest-growing phase of the pipeline industry. Men who have designed, built, and operated remote-controlled and semiautomatic installations present the details of their work in this section. Included are a complete, detailed description of one of the most modern and semiautomatic stations and a discussion of design considerations for unattended stations.

A SPECIAL SECTION OF THE OIL AND GAS JOURNAL



The basis of this graphical method of flow analysis is that pressure, when plotted on geometric coordinates, varies linearly with distance along the pipeline. Note that while actual pressures are given on the two curves shown, the plot is made against a squared scale. Fig. 1.

by

C. W. Marvin

Chief, plans and research,
Texas Eastern Transmission Corp.

Here's a new and practical tool . . . the

GAS-FLOW ANALYZER

for making natural-gas-pipeline flow studies

For the Gas Pipeliner . . .

The charts in this article give you rapid, graphical solutions to all types of gas flow problems—whether they're connected with everyday operations or involved in new-line design.

For the Oil Pipeliner . . .

Six flow charts, pages 164 to 166, give you rapid answers to gathering-system hydraulic problems.

For Both . . .

An easily removable insert containing two handy charts. On one side—the GAS-FLOW ANALYZER. On the other—the OIL-FLOW ANALYZER.

THE pressure distribution of gas flowing through a level natural-gas-transmission pipeline is a straight line on geometric coordinates. Recognition of this fact was the base from which the very useful and extremely simple graphic solution of natural-gas pipeline flow problems presented in this paper was developed.

An illustration of the gas flow characteristic is depicted in Fig. 1. In that plot the four test pressures in each transportation section form a precise straight line. That figure shows field test pressure drop characteristics in a 24 by ⅜-in. pipeline at an approximate flow rate of 330 M.M.c.f.d. when equilibrium conditions have been established. In the picture presented, the line pressures were obtained with 1,000-psi. deadweight gages, and it is significant that during the time of the recorded test (8:00 a.m. to 10:00 a.m.) with pressures obtained every 15 min-

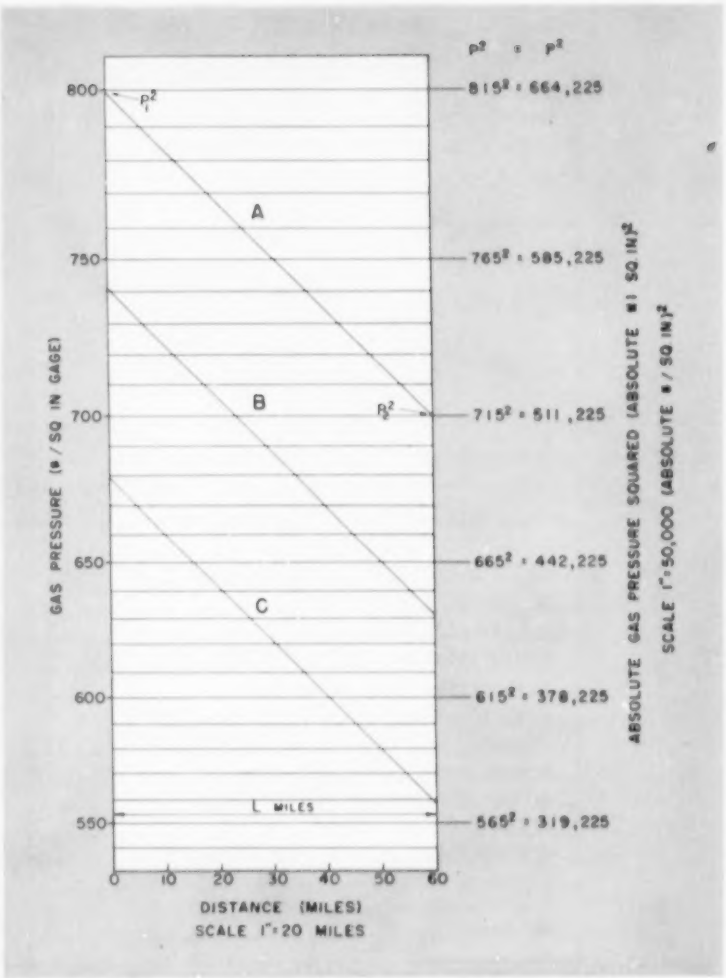
utes, none of the pressures between Station 3 and Station 4, inclusive, had a total variation of more than 0.3 psi.

The illustration, Fig. 1, shows only the results of one flow test, but five other 50-mile sections tested on the same day at the same time also yielded such a precise straight-line plot of pressure vs. distance. Observations on multitudes of similar tests have shown that the linear nature of the plot is consistent and reliable under dissimilar conditions of pipe diameter, length, flowing temperatures, and pressure levels.

The plot shown is on a special pressure grid of nonuniform line spacing which is marked at the left side with a numerically uniform scale of gage pressures. It is such geometric coordinates which permit gage pressure to be plotted as a straight line vs. distance.

The special pressure grid is easy to construct. Determine the equivalent numerical values of the gage pressures of the grid by mathematically squaring the corresponding absolute pressures and plot them to linear scale. For example, in Fig. 1, Column I is the absolute pressure corresponding to the gage pressure in the left margin. Atmospheric pressure was taken as 15 psia. and is sufficiently accurate for the purpose. Column II, in Fig. 1, is the square of the absolute pressure corresponding to the gage pressure in the left margin.

These squares of absolute pressure are plotted to linear scale in Column II. At a scale of 50,000 psi.^{2} per inch of ordinate, the 800 psig. pressure grid plots on an approximate 12-in. ordinate. Column I and Column II and the right-hand margin of Fig. 1 are not normally included on the pressure distribution chart. They are included in Fig. 1 merely to show the mechanism of grid construction. As can be seen, **the special grid is simply a convenient means of plotting the squares of absolute pressure vs. distance in terms of gage pressures and distance.**



Slope of these lines is a function of quantity flowing. Fig. 2.

The pressure distribution grid described has special properties which adapt themselves to an extremely simple and effective solution of the accepted pipeline gas-flow equation.

First, consider the chart, Fig. 2. The slope M of line A is represented by the equation:

$$M = \frac{(P_1^2 - P_2^2)}{L} \qquad (1)$$

Second, consider the Panhandle gas-flow formula. It is:

$$Q = 435.87\ [(P_1^2 - P_2^2)/L]^{0.5394}\ (T_o/P_o)^{1.07881} \times (1/T_f)^{0.5394}\ (1/G)^{0.4606}\ E\ (d)^{2.6182} \qquad (2)$$

where:

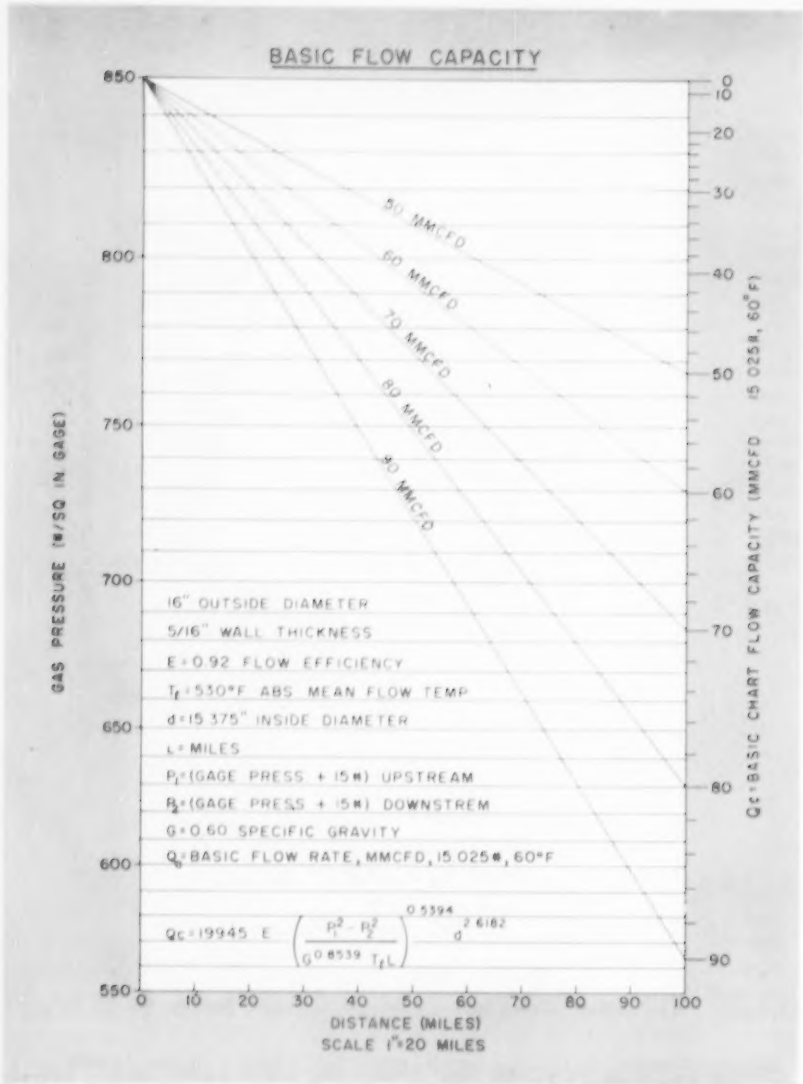
Q = rate of gas flow, cubic feet per day, measured at pressure rate P_o and temperature base T_o.
P_1 = inlet pressure to a section of line, L, psia.
P_2 = outlet pressure to a section of line, L, psia.
L = length of pipe, miles.
T_o = gas measurement temperature base, °F., abs.
P_o = gas measurement pressure base, psia.
T_f = mean flowing temperature of gas in section L, °F., abs.
G = specific gravity of flowing gas, air = 1.0, a decimal.
E = pipeline flow efficiency, a decimal fraction.
d = inside diameter of pipe, in.

Whereupon, for any given measurement temperature base, measurement pressure base, mean flowing temperature, specific gravity of gas, diameter of pipe, and line flow efficiency, Equation 2 reduces to:

$$Q = K'\ [(P_1^2 - P_2^2)/L]^{0.5394} \qquad (3)$$

Where K' is a proportionality constant, and a specific value of $(P_1^2 - P_2^2)/L$ fixes the value of M in Equation 1 and the value of Q in Equation 3.

Simply, **for any given measurement temperature base, measurement pressure base, mean flowing temperature, specific gravity of gas, diameter of pipe and line flow efficiency, the slope of the pressure-distribution line on the chart, Fig. 2, represents the rate of flow of gas through the line.**



Pressure drop vs. distance for various flow rates. Fig. 3.

The slope of the pressure distribution line on the chart, Fig. 2, represents the rate of flow of gas through the line for any flow equation in which Q is a function of $(P_1^2 - P_2^2)/L$, and it is not restricted to the conventional Panhandle equation which is used here as an example only.

Parallel lines A, B, and C in Fig. 2, having the same slope, each represent a given rate of gas flow through the line (under the conditions imposed by the previous paragraph), and it is the same rate of flow for each of the lines A, B, or C.

Thus, an important property of the grid is that **a straight line of a given slope on the pressure-distribution chart represents the same rate of flow** (for the conditions imposed) **regardless of the general pressure level at which it exists.** Further, **each different slope represents a different flowing capacity.**

Fig. 3 is a basic chart solution of pressure distribution vs. various flow rates for a 16-in. o.d. by ⅝-in. wall-thickness pipe 100 miles in length, carrying natural gas of 0.60 specific gravity with an inlet pressure of 850 psig. and a mean flowing temperature of 70° F., in a line of 92 per cent flow efficiency, with volumes measured at a pressure base of 15.025 psi. and temperature base of 60° F.

It was obtained by substituting all of the above values as constants into the Panhandle formula, Equation 2, and solving for P_2 for each of the flow rates portrayed. The P_2's were plotted on the pressure chart in terms of gage pressures and then the straight lines representing the corresponding flow rates were drawn. In this way the basic **chart capacity scale,** Q_c, is derived, and it is shown on the right-hand side of Fig. 3.

Of course, the basic chart capacity scale, Q_c, could be derived for other standard values of flow rates, pipe diameter, pipe-wall thickness, pipe length, specific gravity, inlet pressure, mean flowing temperature, line-flow efficiency, measurement pressure base, measurement temperature base, and scaled distance than that which is shown in Fig. 3, but the essential characteristic would remain the same.

Fig. 4 is a pressure-distribution work chart in the simplest form. The pressure grid and Q_c scale are determined as indicated in previous paragraphs. To determine the pressure drop for the standard conditions in the 16 by ⅝-in. pipe as described for Fig. 3, merely draw a line connecting the 850-psig. graph origin point with the indicated volume on the right-hand scale (60 M.M.c.f.d. in the example).

To determine the pressure distribution for the same 60 M.M.c.f.d. volume in the same pipe conditions, but at another inlet pressure, say 780 psig., simply draw the parallel line AB from 780 psig. Two full-sized drafting triangles facilitate the work as shown in Fig. 4.

To employ Fig. 4, which is a solution of base conditions, as a means of solving any conditions of flow, a simple auxiliary equation is used to adjust flow conditions to standard base conditions of the 16 by 5/16-in. pipe.

The auxiliary equation used in conjunction with the charts is:

$$Q_c = \frac{0.9106\,HQ}{FE} \qquad (4)$$

where:

Q_c = chart capacity on the scale of Fig. 4, M.M.c.f.d., 15.025 psi., 60° F., corresponding to 0.60-gravity gas flowing in 16 by ⅝-in. pipe at 60° F. mean flowing temperature, and a pipeline-flow efficiency of 0.92.

Gas-Flow Analyzer

Q = actual capacity flowing, M.M.c.f.d., 15.025 psi., 60° F.

E = actual flow efficiency, decimal.

H = diameter factor expressed by Equation 5 immediately below.

$$H = \frac{d_{16}^{2.6182}}{(d_1^{2.6182} + d_2^{2.6182} \ldots + d_n^{2.6182})}$$

$$= \frac{1{,}281}{(d_1^{2.6182} + d_2^{2.6182} \ldots + d_n^{2.6182})} \quad (5)$$

where:

d_{16} = inside diameter of base pipe, in. In this instance for 16 by ¼-in. pipe it is 15.375 in.

d_1 = inside diameter of pipe.

d_2 = inside diameter of parallel pipe loop.

d_n = inside diameter of nth parallel pipe loop.

In the event that there are no parallel loops, terms containing d_2 and d_n are merely zero.

F = factor adjusting for actual flowing temperature and specific gravity.

$$F = (520/T_f)^{0.5394} (0.60/G)^{0.4606} \quad (6)$$

T_f = actual flowing temperature, °F. abs.

G = actual gas specific gravity.

For convenience, tables of H and F values for the auxiliary Equation 4 can be computed from the base established. Fig. 5 is a brief table of H values, and of course it can be made more extensive. Fig. 6 is a tabulation of F values and it can be expanded as shown in Fig. 7.

Referring back to Equation 4, the value of 0.9106 H/FE is conveniently referred to as the chart factor, F_c. It is a number which can be multiplied by the actual quantity flowing, Q_1 to obtain Q_c—the number used with the charts. The concept of F_c is easy to grasp, and in natural-gas-transmission problems, where the specific gravity is, oftener than not, constant for any given system, where line flow efficiencies are relatively constant for long periods of time, and where assumed mean flowing temperatures are taken as constant without introducing appreciable errors, the chart factor is a highly serviceable tool.

The development of the auxiliary Equation 4 is made directly from the basic gas-flow Equation 2. Setting out the measurement temperature base and measurement pressure base as 60° F. and 15.025 psi., respectively, Equation 2 becomes for one pipe:

$$Q_1 = 19{,}945\ [(P_1^2 - P_2^2)/L]^{0.5394}\ (1/T_f)^{0.5394} \times (1/G)^{0.4606} E\,(d_1)^{2.6182} \quad (7)$$

For a parallel loop pipe of the same length and with the same gravity gas flowing at the same mean flowing temperature and between the same terminal pressures:

$$Q_2 = 19{,}945\ [(P_1^2 - P_2^2)/L]^{0.5394}\ (1/T_f)^{0.5394} \times (1/G)^{0.4606} E\,(d_2)^{2.6182} \quad (8)$$

$$Q_1 + Q_2 = 19{,}945\ [(P_1^2 - P_2^2)/L]^{0.5394}\ (1/T_f)^{0.5394} \times (1/G)^{0.4606} E\,(d_1^{2.6182} + d_2^{2.6182}) \quad (9)$$

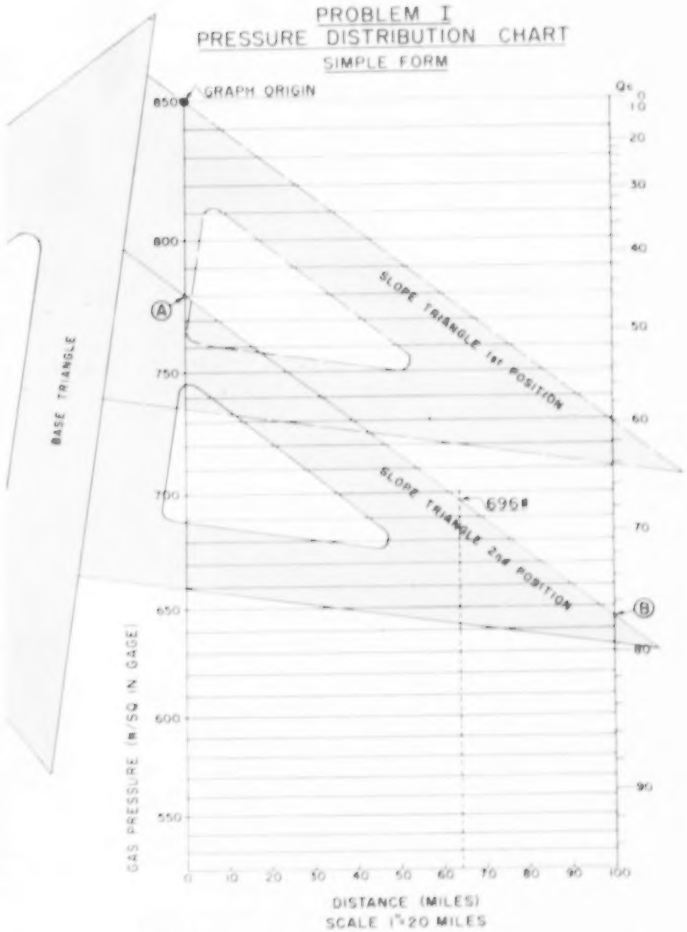
Similarly it can be shown that:

$$Q_1 + Q_2 \ldots + Q_n = 19{,}945\ [(P_1^2 - P_2^2)/L]^{0.5394}\ (1/T_f)^{0.5394} \times (1/G)^{0.4606} E\,(d_1^{2.6182} + d_2^{2.6182} \ldots + d_n^{2.6182}) \quad (10)$$

Since $Q_1 + Q_2 \ldots + Q_n$ is the sum of all the gas flowing in the parallel pipes:

$$Q = 19{,}945\ [(P_1^2 - P_2^2)/L]^{0.5394}\ (1/T_f)^{0.5394} \times (1/G)^{0.4606} E\,(d_1^{2.6182} + d_2^{2.6182} \ldots + d_n^{2.6182}) \quad (11)$$

Setting out the standard chart capacity as being that quantity of 0.60 specific gravity natural gas which will



Graphical methods give pressure distribution for various inlet pressures. Fig. 4.

flow through 16-in. o.d. by ⅜-in. wall-thickness pipe of 0.92 flow efficiency at a mean flowing temperature of 70° F., with volumes reported at 60° F. and 15.025 psi., respectively, as has been presented in Fig. 3, Equation 2 becomes:

$$Q_c = 19{,}945\ [(P_1^2 - P_2^2)/L]^{0.5394}\ (1/530)^{0.5394} \times (1/0.60)^{0.4606}\ (0.92 \times 1{,}281) \qquad (12)$$

Dividing Equation 12 by Equation 11:

$$Q_c/Q = \frac{0.92 \times 1{,}281}{(530/T_f)^{0.5394}\ (0.60/G)^{0.4606}} \times \frac{1}{(d_1^{2.6182} + d_2^{2.6182} \ldots + d_n^{2.6182})} \qquad (13)$$

Since:

$$(530/T_f)^{0.5394} = 1.0103\ (520/T_f)^{0.5394} \qquad (13a)$$

Setting:

$$F = (520/T_f)^{0.5394}\ (0.60/G)^{0.4606} \qquad (6)$$

$$H = \frac{1{,}281}{(d_1^{2.6182} + d_2^{2.6182} \ldots + d_n^{2.6182})} \qquad (5)$$

Equation 4 evolves:

$$Q_c = \frac{0.9106\ HQ}{FE} \qquad (4)$$

Note: If the basic chart factor, Fig. 3, had been derived on the basis of 60° F. mean flowing temperature instead of 70° F. mean flowing temperature, the auxiliary Equation 4 would have 0.92 as a constant instead of 0.9106.

Problem I...

An example of the use of Fig. 4, Fig. 5, and Fig. 7 to solve the simplest flow problem follows:

Conditions: A 24 by ⅜-in. pipeline between two compressor stations is 64 miles long and flows 174.5 M.M.c.f.d. of 0.60 specific gravity natural gas. The upstream compressor station discharges at 780 psig. The line flowing efficiency is 92 per cent. The mean flowing temperature is 85° F. **What is the downstream compressor station suction pressure?**

Solution:

From Fig. 5,

$H = 0.3388$ for 24 by ⅜-in. pipe.

From Fig. 7,

$F = 0.9750$ for mean flowing temperature T_f of 85° F. and a specific gravity of 0.60.

$E = 0.92$, specified in the problem.

$Q = 174.5$ M.M.c.f.d., specified in the problem.

$P_1 = 780$ psig.

From Equation 4:

$$Q_c = \frac{0.9106 \times 0.3388 \times 174.5}{0.9750 \times 0.92} = 60$$

Note how easily the numerical value of Q_c can be obtained with a slide rule.

Align the triangles in first position as shown in Fig. 4 to make a straight edge from the graph origin to $Q_c = 60$. Move the slope triangle to the second position with 780 psig. at the upstream station (zero mileage). Draw the line AB. The pressure 64 miles downstream along the line is 696 psi. as shown on the chart.

If the downstream pressure were known, a similar process could be used to determine the upstream pressure.

H VALUES

Main pipe (in.)		Loop line (in.)		Additional loop pipe (in.)		
Nominal outside diam.	Wall thickness	Nominal outside diam.	Wall thickness	Nominal outside diam.	Wall thickness	H value
10¾	3/8					2.99
14	1/4					1.408
16	5/16					1.0000
16	9/32					0.9900
20	5/16					0.5460
20	9/37					0.5414
24	3/8					0.3388
26	9/32					0.2678
26	5/16					0.2695
26	11/32					0.2712
30	3/8					0.1858
20	9/32	16	9/32			0.3544
20	9/32	16	5/16			0.3512
20	5/16	16	9/32			0.3519
20	5/16	20	9/32			0.2718
20	3/8	20	3/8			0.2778
20	5/16	24	3/8			0.2091
20	5/16	24	3/8	26	9/32	0.1174

Note 1: H is a function of inside pipe diameters and the number of parallel loop lines, if any. Equation 5 defines H. The base pipe in this table is 16-in. o.d. by 5/16-in. wall thickness.

Note 2: H is used in evaluating the auxiliary Equation 4.

Fig. 5

F VALUES

Mean flowing temp., °F.	Specific gravity				
	0.60	0.61	0.613	0.616	0.620
40	1.0215	1.0137	1.0115	1.0092	1.0062
45	1.0159	1.0082	1.0059	1.0037	1.0007
50	1.0105	1.0028	1.0006	0.9984	0.9954
55	1.0052	0.9976	0.9954	0.9931	0.9901
60	1.0000	0.9924	0.9902	0.9880	0.9850
65	0.9949	0.9873	0.9851	0.9829	0.9799
70	0.9898	0.9823	0.9801	0.9779	0.9750
75	0.9848	0.9773	0.9751	0.0730	0.9700
80	0.9799	0.9725	0.9703	0.9681	0.9652
85	0.9750	0.9676	0.9654	0.9633	0.9604
90	0.9702	0.9628	0.9607	0.9586	0.9556

Note 1: F is defined by Equation 6.

Note 2: F is used to evaluate auxiliary Equation 4.

Fig. 6

EXPANDED TABLE OF F VALUES

$$F = [520/(t_f + 460)]^{0.5394} \times (0.60/G)^{0.4606}$$

Flowing temp., t_f	Specific gravity									
	.600	.601	.602	.603	.604	.605	.606	.607	.608	.609
65	.9949	.9941	.9934	.9926	.9918	.9911	.9903	.9896	.9888	.9881
66	.9938	.9930	.9923	.9915	.9907	.9900	.9892	.9885	.9877	.9870
67	.9928	.9920	.9913	.9905	.9897	.9890	.9882	.9875	.9867	.9860
68	.9918	.9910	.9903	.9895	.9887	.9880	.9872	.9865	.9858	.9851
69	.9908	.9900	.9893	.9885	.9877	.9870	.9862	.9855	.9848	.9841
70	.9898	.9890	.9883	.9875	.9867	.9860	.9852	.9846	.9838	.9831
71	.9888	.9880	.9873	.9865	.9857	.9850	.9843	.9836	.9828	.9821
72	.9878	.9870	.9863	.9855	.9847	.9840	.9833	.9826	.9818	.9811
73	.9868	.9860	.9853	.9845	.9837	.9831	.9823	.9816	.9808	.9801
74	.9858	.9850	.9843	.9835	.9827	.9821	.9813	.9806	.9798	.9791
75	.9848	.9840	.9833	.9825	.9817	.9811	.9803	.9796	.9788	.9781
76	.9838	.9830	.9823	.9815	.9808	.9801	.9793	.9786	.9778	.9771
77	.9828	.9820	.9813	.9805	.9798	.9791	.9783	.9776	.9768	.9761
78	.9818	.9810	.9803	.9795	.9788	.9781	.9773	.9766	.9758	.9751
79	.9809	.9801	.9794	.9786	.9779	.9772	.9764	.9757	.9749	.9742
80	.9799	.9791	.9784	.9776	.9769	.9762	.9754	.9747	.9739	.9732
81	.9789	.9781	.9774	.9766	.9759	.9752	.9744	.9737	.9729	.9722
82	.9779	.9771	.9764	.9757	.9749	.9742	.9734	.9727	.9719	.9713
83	.0769	.9761	.9754	.9747	.9739	.9732	.9724	.9717	.9709	.9703
84	.9760	.9752	.9745	.9738	.9730	.9723	.9715	.9708	.9700	.9694
85	.9750	.9742	.9735	.9728	.9720	.9713	.9705	.9698	.9691	.9684
86	.9740	.9732	.9725	.9718	.9710	.9703	.9695	.9688	.9681	.9674
87	.9731	.9723	.9716	.9709	.9701	.9694	.9686	.9679	.9672	.9665
88	.9721	.9713	.9706	.9699	.9691	.9684	.9676	.9669	.9662	.9655
89	.9712	.9704	.9697	.9690	.9682	.9675	.9667	.9660	.9653	.9646
90	.9702	.9694	.9687	.9680	.9672	.9665	.9657	.9651	.9643	.9636

Fig. 7

In practice, flow studies of the operations of a major, long-distance, large-diameter, gas pipeline are so frequent, so complex, and often as not, so urgent that more detailed and appropriate flow charts are warranted. Fig. 8 shows a section of one of seven pressure-distribution charts which define the entire Texas Eastern facility and are currently used by the author for design and operational flow studies of Texas Eastern Transmission Corp.

The detailed flow chart has the same basic pressure grid and Q_c scale described in Fig. 4. In the instance of Fig. 8, the compressor-station milepost locations are set out to scale along the abscissa. Intermediate purchase or sales meter-station mileposts are also marked to scale by vertical lines on the graph with identification at the top of each line. The vertical lines are called location lines. A simplified schematic of the transmission lines is placed below the grid where mileage, diameters, and wall thickness and the all important H factor are readily available.

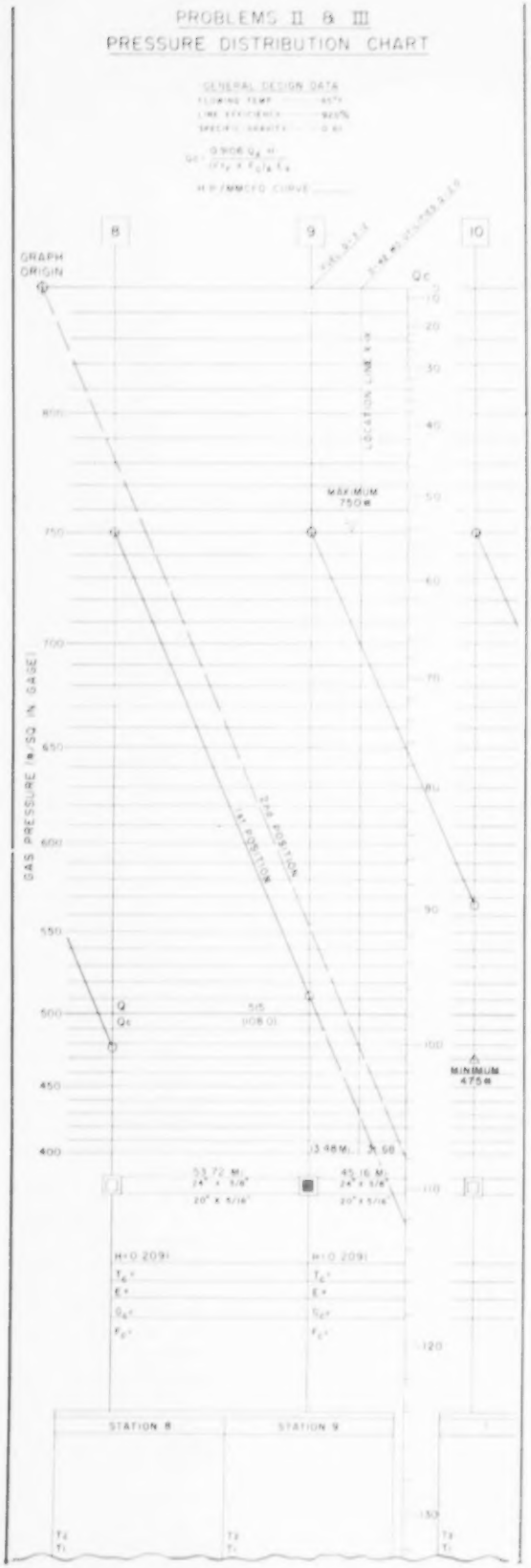
The flow chart is a work sheet, so that spaces are provided where the volume balance can be made. Each sales meter tap is identified by location and customer company or consumer, and a space to fill in the sales quantity is provided. Space to show fuel consumption is given where appropriate. Losses are taken in location and quantity in accordance with the records and judgments.

Gas-Flow Analyzer

Capacities flowing along each section of line are identified on the Q line, in this instance directly above the 500-psig. pressure line. Chart capacities, as computed, are shown in parenthesis on the Q_c line, just below the 500-psig. pressure line.

Performance of the system may be completely depicted on the chart. For example, between Station 8 and Station 9, 515 M.M.c.f.d. flows from Station 8 discharge at 750 psig. along 53.72 miles of 24 by ⅜-in. and 20 by ⅞-in. line in parallel to suction of Station 9 at 513 psig., where 3.12 M.M.c.f.d. is consumed as fuel in the reciprocating engines. A sale of 2 M.M.c.f.d. is made to a distributing company 13.48 miles east of the discharge of Station 9 at meter tap D-42. H values for the line are shown as 0.2091. Pipeline efficiency is 92 per cent, mean flowing temperature is 65° F. Fig. 8 has been reduced considerably from the size of the original.

The panorama of the line presented by this chart includes many details important to flow studies. Maximum operating pressure of the pipelines can be indicated, so the engineer will be cognizant of such limitation. Other conditions can be indicated also, e.g., minimum obligations of sales delivery pressures, maximum or minimum contract purchase pressures, which ever is applicable, etc. Boxes are provided for computations and results describing compressor station performance. Equation 4 is on the chart for ready reference.



Use of charts to determine line efficiency. Fig. 8.

Problem II...

Application of these flow charts to determine pipeline efficiency is simple. An example is given (see Fig. 8).

Conditions: 515 M.M.c.f.d. of 0.61 specific gravity gas flow from Station 8 at 750-psig. discharge pressure to Station 9 at 513 psig. suction pressure. The line is 53.72 miles of 24 by ⅜-in. pipe in parallel with 20 by ⁵⁄₁₆-in. pipe. The mean flowing temperature has been determined to be 65° F. **What is the line efficiency?**

Solution:

See Fig. 8, Station 8 to Station 9, where the pressure-distribution line for the above problem has been drawn. Using the triangles, place them with the slope triangle on the pressure-distribution line as in first position. Move the slope triangle to second position to ascertain Q_c to be 108.0 as shown by the dotted lines. Employ Equation 4 solve for efficiency E. Rewriting Equation 4:

$$E = 0.9106\ (HQ/FQ_c) \qquad (4a)$$

where:

Q = 515 M.M.c.f.d., specified in problem.

Q_c = 108.0 M.M.c.f.d., as determined from the chart, above.

H = 0.2091 for 24 by ⅜-in. in parallel with 20 by ⁵⁄₁₆-in., as shown on Fig. 8 pressure-distribution chart, or as determined from Fig. 5.

F = 0.9873, as determined from Fig. 6 for mean flowing temperature T_f of 65° and a specific gravity of 0.61.

$$E = \frac{0.9106 \times 0.2091 \times 515}{0.9873 \times 108.0} = 0.92$$

Problem III...

The chart can be used to determine the volume which will flow between two pressures.

Conditions: With a flow efficiency of 92 per cent, **how much gas will flow** along 53.72 miles of 24 by ⅜-in. pipe in parallel with 20 by ⁵⁄₁₆-in. pipe from 750 psig. to 513 psig. if the mean flowing temperature is 65° F.?

Solution:

Set the slope triangle along the pressure distribution line, as in first position, Fig. 8. Move the slope triangle to intercept the graph origin as in position 2, thus determining Q_c to be 108.0. Solve for Q, using Equation 4. Rewriting Equation 4:

$$Q = (EFQ_c/0.9106H) \qquad (4b)$$

where:

E = 0.92, specified in problem.

F = 0.9873, as determined from Fig. 6 for mean flowing temperature T_f of 65° F. and a specific gravity of 0.61.

H = 0.2091 for 24 by ⅜-in. pipe in parallel with 20 by ⁵⁄₁₆-in.

$$Q = \frac{0.92 \times 0.9873 \times 108.0}{0.9106 \times 0.2091} = 515 \text{ M.M.c.f.d.}$$

Problem IV...

When sales are made along the line, one real contribution of the flow chart—speedy solution—is apparent. As

an example of a system with **two parallel lines partially looped with a third line** and **with a number of sales** made from the line, consider the following problem:

Conditions: 654 M.M.c.f.d. is discharged from Station 19 at 750 psig. The gas flows through the 24 by 5/8-in., 20 by 5/8-in., and 26 by 9/32-in. pipes in parallel for 19.82 miles where the 26-in. loop stops. The gas commingles and continues to pass through the 20 and 24-in. lines in parallel to Station 20.

At a point of 25.43 miles from Station 19, 107.5 M.M.c.f.d. of gas is sold from the 20 and 24-in. lines, at a point 34.07 miles from Station 19 a 25-M.M.c.f.d. parcel of gas is sold, at a point 46.0 miles from Station 19, another parcel of 10 M.M.c.f.d. is delivered, and at a point 52.56 miles from Station 19 (6.56 miles from the suction of Station 20) a quantity of 87.5 M.M.c.f.d. is delivered to a customer. The specific gravity of the gas is 0.61. The mean flowing temperature is 50° F. and the lines have been demonstrated to be 92 per cent efficient. **What will be the suction pressure at Station 20?**

Solution:

See Fig. 9, Station 19 to Station 20.

For the three lines in parallel:

H = 0.1174 as shown on the chart Fig. 8, or as determined from Fig. 5 for the three pipes in parallel.

F = 1.0028 as determined from Fig. 6 for a mean flowing temperature of 50° F. and a specific gravity of 0.61.

E = 0.92, as specified in the problem.

Q = 654 M.M.c.f.d.

From Equation 4:

$$Q_c = \frac{0.9106 \times 0.1174\,Q}{1.0028 \times 0.92} = 0.1159\,Q$$

$$Q_c = 0.1159 \times 654 = 75.80$$

From the two lines in parallel:

H = 0.2091 as shown on the chart Fig. 8, or as determined from Fig. 5 for 24 by 5/8-in. in parallel with 20 by 5/8-in.

F = 1.0028 as determined from Fig. 6 (see above).

E = 0.92, as specified in the problem.

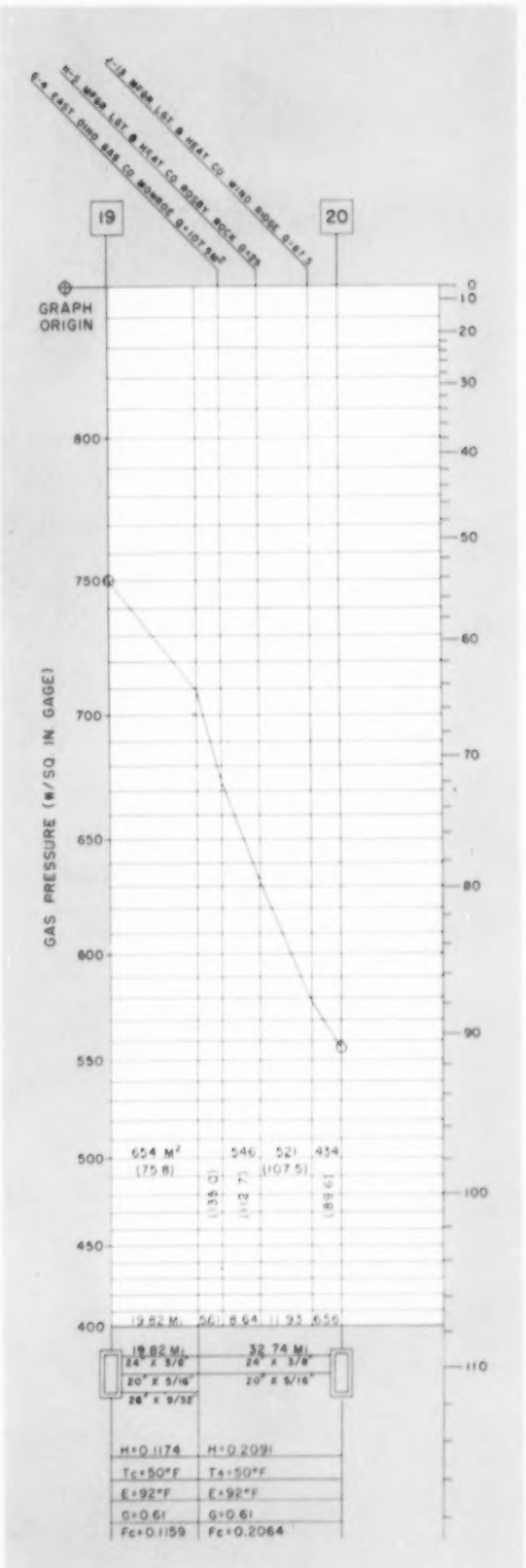
From Equation 4:

$$Q_c = \frac{0.9106 \times 0.2091\,Q}{1.0028 \times 0.92} = 0.2064\,Q$$

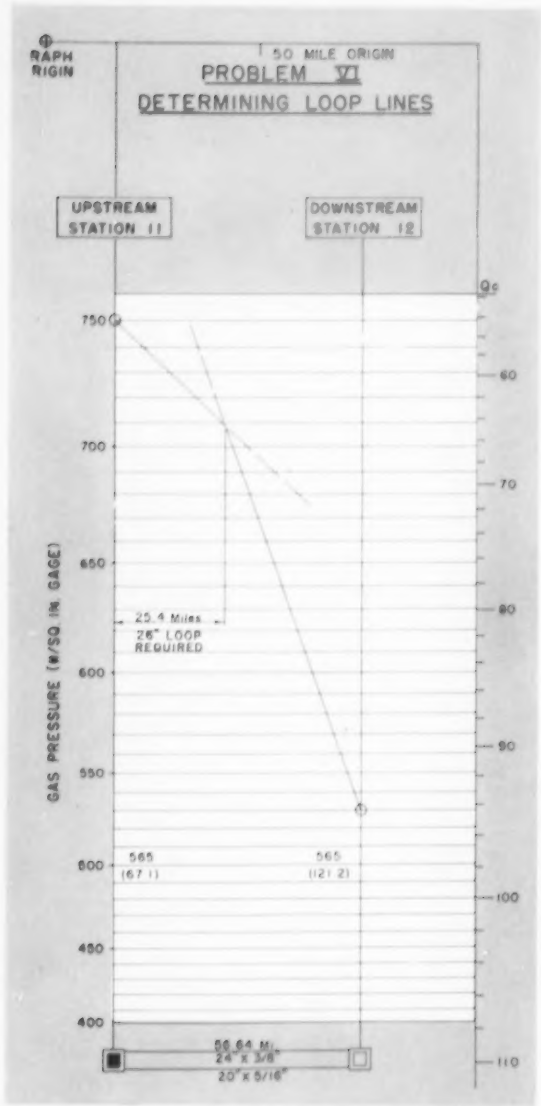
Tabulating for clarity:

Section—	Sale M.M.c.f.d.	Q M.M.c.f.d.	$Q_c = 0.2064\,Q$ M.M.c.f.d.
End 26-in. loop to first sale		654	135.0
First sale	107.5		
First sale to second sale		546	112.7
Second sale	25		
Second sale to third sale		521	107.5
Third sale	87.5		
Third sale to Station 20		434	89.6

Work space is provided on the flow chart, and all the above computations are on it. Using the triangles, construct the first portion of the pressure distribution line along the three lines in parallel from the 750-psi. discharge at Station 19, using the calculated $Q_c = 75.8$ for that section. The pressure at the end of the three loops is



A few straight lines give quick solution to gas-withdrawal problem. Fig. 9.



Charts are also used to determine required loop capacity. Fig. 10.

thus fixed at 710 psig. Construct the second portion of the distribution line along the two lines in parallel from the end of the 26-in. loop using the calculated $Q_c = 135.0$ for that section. The pressure at the first sale is thus fixed at 673 psig. The procedure is repeated on consecutive sections of the line, thus determining the suction pressure at Station 20 to be 557 psig. as sought.

It is to be noted that, using the triangles to fix the slope between the graph origin point and the Q_c scale, no line need be drawn other than the pressure distribution line at the correct value and in the proper section, as shown in Fig. 9. Actually, only the pressure points need fixing.

Especially note that with the distribution line drawn, if a pressure at a highway or railroad crossing was required, it would be easily determinable by merely fixing its milepost location along the line.

Gas-Flow Analyzer

Problem V...

When pipe diameters change along the lines, the respective H values of the sections are used and procedure of Problem IV is applied to obtain downstream of upstream pressures.

Problem VI...

How much loop line is required to increase the capacity of a given system in an expansion program? This problem generally calls for resolution of equivalent lengths and concepts not easily kept clear in the mind. The flow charts reduce the problem to utter simplicity as will be shown.

Conditions: The normal capacity of a section of line discharging at 750 psig. is 520 M.M.c.f.d. Refer to Fig. 10. The line is 56.64 miles long with 24 by ⅜-in. and 20 by ⅝-in. pipe in parallel. Existing lines have a flow efficiency of 90 per cent. The normal mean flowing temperature is known to be 75° F., and the gas is 0.60 specific gravity. The downstream station is a conventional reciprocating type. It has 10,000 useful horsepower available. To simplify this problem it is assumed that the design of the compressor cylinders will permit the engines to be operated fully loaded from a compression ratio of 1.3 to 2.0. That is consistent with good design practice today.

How many miles of 26 by 9/32-in. line are required to increase the capacity of the section to 565 M.M.c.f.d. without adding any horsepower?

Solution:

For the section to be looped, (20 by ⅝-in., 24 by ⅜-in., and 26 by 9/32-in.):

H = 0.1174, see Fig. 5.
F = 0.9848, see Fig. 7.
E = 0.90.

From Equation 4:

$$Q_c = \frac{0.9106 \times 0.1174\,Q}{0.9848 \times 0.90} = 0.1189\,Q = 0.1189 \times 565 = 67.1$$

For the parallel lines, (20 by ⅝-in., 24 by ⅜-in.):

H = 0.2091, see Fig. 5.
F = 0.9848, see Fig. 7.
E = 0.909.

From Equation 4:

$$Q_c = \frac{0.9106 \times 0.2091\,Q}{0.9848 \times 0.90} = 0.2146\,Q = 0.2146 \times 565 = 121.2$$

Determine the suction pressure of the downstream station at the 565 M.M.c.f.d. capacity. With 750 psig. discharge, and using a standard horsepower per M.M.c.f.d. curve (Cooper-Bessemer Curve NN 16-2 corrected by Curve NN 17-4 and compressibility at suction conditions in this illustration) the suction pressure computes to be 530 psig.

Draw the pressure-distribution line for the three parallel lines down from 750 psi. at the upstream station toward

the downstream station. Draw the pressure distribution for the two parallel lines up from 530 psig. at the downstream station toward the upstream station. The intersection of these lines is the solution for the miles of loop. Scale the distance from the upstream station to the end of the three parallel lines to determine the required length of loop, which in this case is 25.4 miles.

It may be noted here, from a consideration of the character of the chart in Problem 6 that whether the parallel loop is placed at the upstream station or whether it is placed at the downstream station makes no difference in the flow characteristic. The length of the loop line required is the same.

Real factors to loop placement are, however, location, number, size, and nature of rivers to be crossed; number of laying spreads required; terrain, etc. Generally speaking, however, all other factors not considered, in the case of a section of line with substantial sales along its length, the loop should be placed in the location where it will carry the most volume.

Problem VII...

One of the most valuable attributes of the pressure-distribution chart is its extreme usefulness in solving flow problems peculiar to a chain of pipeline and compressor stations.

Conditions: Fig. 11 grid represents a series of compressor stations on a single 30 by 3/8-in. pipeline. Station spacing, pipe size, diameter, thickness, maximum working pressure, installed horsepower at the stations, mean flowing temperature, pipeline efficiency, fuel consumption, and specific gravity for the system are as shown on the chart.

The reciprocating stations are assumed (for simplification in this example only) to perform in accordance with standard horsepower per M.M.c.f.d. curves as noted in Problem 6, and the cylinders are such as to permit the engines to operate at 100 per cent torque load throughout a compression ratio of 1.4 to 1.9.

Consider a complete shutdown of Station B. Assuming that the engines at the remaining stations will be loaded to 100 per cent rated torque load. **What will be the flow capacity of the system with Station B out of service?**

Solution:

The work to solve this problem is substantially reduced by use of the chart.

The chart factors Q_c/Q are first established for each section using Equation 4.

Based on 80° F. mean flowing temperature, 0.60 specific gravity, 92 per cent flow efficiency:

$$Q_c = \frac{0.9106 \times 0.1858\,Q}{0.9799 \times 0.92} = 0.1877\,Q$$

Trial 1—Assume capacity of 450 M.M.c.f.d.

Particular—	Fuel or sale M.M.c.f.d.	Q M.M.c.f.d.	Q_c M.M.c.f.d.
Station A to Station C		450.0	84.5
Fuel Station C	1.6		
Station C to Sale		448.4	84.1
Sale	25.0		
Sale to Station D		423.4	79.4
Fuel Station D	1.6		
Station D to Station E		422.0	78.8

Draw pressure distribution line (upper dotted line A in Fig. 11) from 935 psig. at Station A to Station C, using $Q_c = 84.5$. Compute discharge pressure of Station C with horsepower M.M.c.f.d. curves at 100 per cent engine load rating and capacity of 448.4 M.M.c.f.d. Discharge pressure is 827 psig. Proceed station by station.

Note: In Trial 1 it becomes evident that more capacity can flow than was estimated, so a larger volume is tried.

Trial 2—Assume capacity of 490 M.M.c.f.d. Lower dotted line B, Fig. 11, results. Since the discharge and suction of Station D are less than for Station C, a "run-out" is apparent, and the volume is greater than can be transported.

Trial 3—Assume capacity of 470 M.M.c.f.d. Solid line C, Fig. 11, results. Since the discharge pressures of Stations C, D, and E are progressively higher, full recovery to 935 psig. maximum working pressure is assured at the next station, and 470 M.M.c.f.d. is the capacity with Station B out of service.

A volume of 465 M.M.c.f.d. would make full recovery of 935 psig. at Station E. That can be determined by inspection of the chart, no calculations required.

The effect of compressibility on the flow of gas is recognized, and it can be accounted for in the chart solution. In Equation 2, the value of E can be thought of as a composite of two factors—(1) an absolute pipe-flow efficiency, and (2) the compressibility effect on flow. Thus E may be resolved:

$$E = eF_z \qquad (14)$$

where:

E = effective pipeline-flow efficiency, a decimal, used in Equation 2.

e = absolute pipe-flow efficiency, also a decimal.

$$F_z = (1/Z)^x \qquad (15)$$

where:

F_z = a factor accounting for the effect of compressibility on the flow character of a line.

Z = deviation of the gas from Charles' and Boyles' laws, commonly referred to as the compressibility factor. Its value is taken for the mean flowing temperature and mean flowing pressure in the line.

x = exponent, reported as 0.5 by some engineers and as a slightly different figure by others.

When x is 0.5, F_z corresponds to the commonly accepted F_{pv} factors of orifice meter measurement calculations.

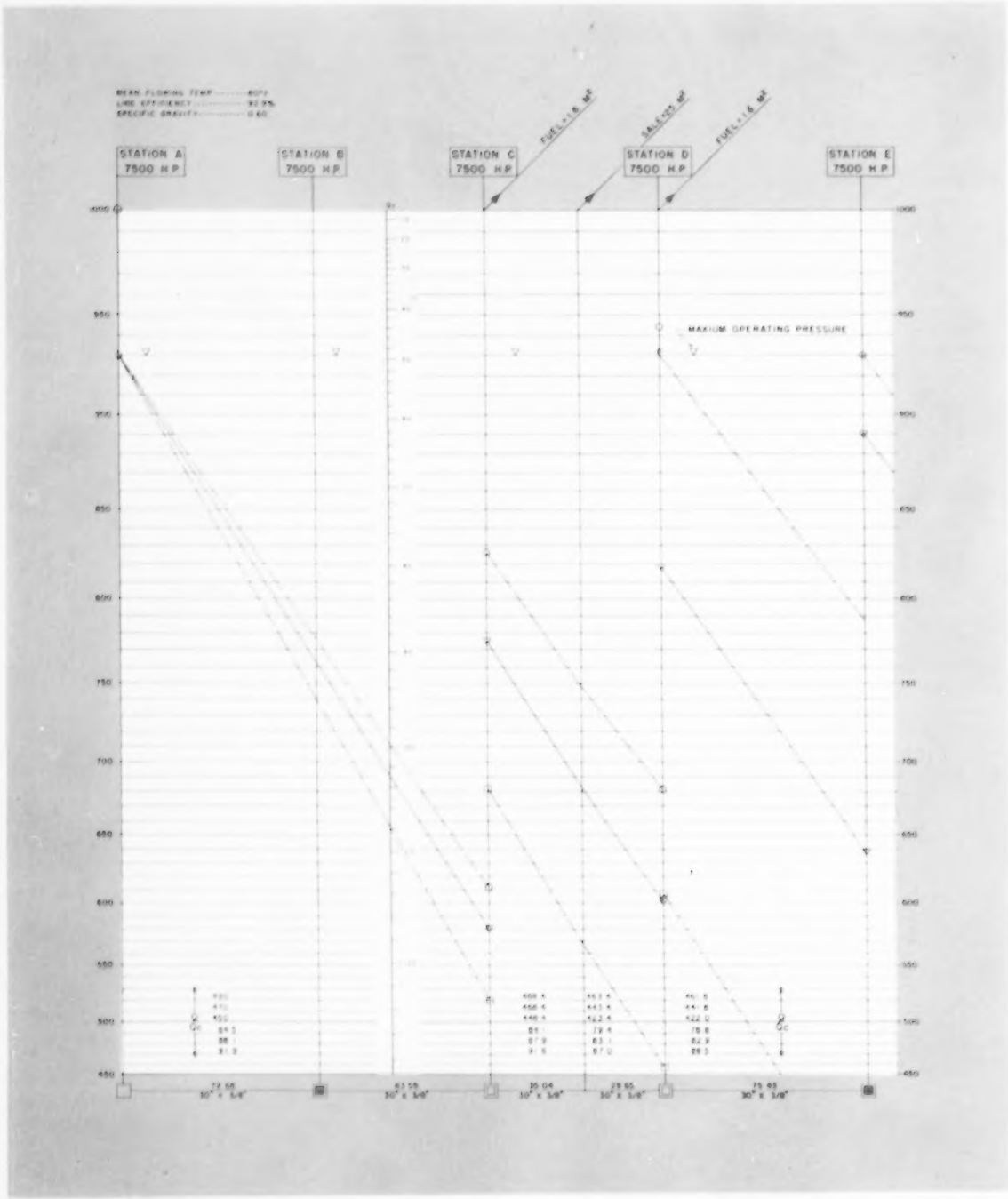
If the value of e is assumed or has been experimentally and accurately determined, Equation 14 will be the base from which appropriate values of E can be calculated for use in Equation 4.

In the contemplation of extremely large quantities through lines, the value of Q_c may be larger than can be reasonably compassed by the standard chart. The solution of this occasional problem is quite simple. Merely compute Q_c in the regular fashion, multiply it by a constant 0.688 to obtain Q_{c1}. Whereas Q_c is used in conjunction with an origin point 100 miles from the Q_c scale. Q_{c1} is used in conjunction with an origin point only 50 miles from the Q_c scale.

Nothing more is required on the pressure-distribution chart than a new origin point 50 miles distant from the Q_c scale. A 50-mile origin point is marked at the top of Fig. 10.

Derivation of the relation of Q_{c1} and Q_c follows:

At 100 miles:



Flow-rate determination for long line with one or more stations inoperative. Fig. 11.

$$Q_c = K\,(P_1^2 - P_2^2)^{0.5391}$$

At 50 miles, one half the distance:

$$Q_{c1} = K\,[(P_1^2 - P_2^2)^{0.5391}]/2$$

$$Q_{c1} = (1/2)^{0.5391}\,Q_c = 0.688\,Q_c$$

A 25-mile origin could also be derived.

Gas-Flow Analyzer

A word about chart construction may be appropriate at this point. Full detailed charts of the Texas Eastern pipelines have been made as originals in ink on both vellum and acetate paper. Temporary and proposed location lines and mileages are made in pencil with dotted lines until final mileposts are determined. Acetate paper is virtually free from shrinkage with changes of humidity. Changes and corrections are more readily made on the vellum.

The pressure grid and the chart volume, Q_c, scale must be accurately drawn, but, because the Q_c scale is

integral with the grid, atmospheric effects do not change the dimensions of the one relative to the other, and accuracy is maintained.

A number of origin points and corresponding Q_c scales are placed upon the grid primarily to favor the use of draftsman's triangles in solving problems, but their proximity to each other assists materially in maintaining accuracy in spite of atmospheric induced distortions. The originals are filed in flat drawers.

Prints . . . The actual work sheets are made as sepia prints. This type print has two distinct characteristics highly suitable to the flow problems. (1) The grid is printed on the reverse face of the work sheet and shows through the sheet as muted, subdued, light-brown lines, readily seen, but not heavy enough to obstruct interpretation of the pressure-distribution lines. (2) Blue-line prints can be made from the completed system solution on the sepia for use at conferences or in reports.

Work sheets . . . These can be filed in quantity in flat drawers. The vertical scale employed is 50,000 psi.^{2} per inch of ordinate. The horizontal scale is 1 in. = 20 miles. These scales were selected for the main transmission lines, because the slopes of the pressure-distribution lines at flow rates encountered are convenient to handle. Also, accuracy is served best by these scales. With these scales, the complete chart of Fig. 11, representing nearly 800 miles of 30-in. pipeline and including all titles and borders is 29⅜ by 41⅝ in., trim line to trim line. This is the longest chart of seven which comprise the system. Others are shorter in length, but all are the standard width. The charts are not clumsy to use. Marking ticks indicating fold lines are convenient to use.

Accuracy . . . This chart method has proved to be well within the limits of practical flow study solution, and for direct solution of Q between two pressures is in the neighborhood of ½ per cent or less.

As the basic origin and chart volume scale Q_c are integral with the pressure grid, other scales than the one used for the main transmission lines are used when more appropriate, e.g., when considering permanent lateral distribution lines at lower pressures. Simple laterals may be portrayed in many instances right on the basic chart. An alternate method is to group a number of laterals on a separate chart.

General form . . . For those problems which are of an ephemeral nature and occur spasmodically so that they do not warrant preparation of the detailed flow charts described previously, a simplified general form is used which does not have particular mileages or location lines laid out upon it. Rather, only general vertical location lines are marked at 50-mile intervals. In using the general charts, the actual mileage and location lines are drawn as known or developed in the process of solution, using the 50-mile interval lines as parallel aids.

The general chart in its application is fully as useful as the specific charts, and all procedures of solution are the same. The general flow chart is a real boon in solving station spacings for new transmission projects and for general plotting.

These descriptions and derivation of the pressure-distribution charts have been presented along with illustrations of the procedure of solution of several distinct primary problem types. These solutions are hardly a complete list, but they serve chiefly to show the fundamental principle involved in application of graphic solutions with the charts. As a tool for analysis of pipeline operations it is unparalleled. Bottlenecks to flow can be discovered and studies of corrective measures clearly delineated in alternate forms if necessary. In such alternate presentations various colored lines have been useful.

With a system presented on the charts, line pack, i.e., gas in transit, is a graphic concept which can be visually compared, since the area under the line is a measure of the line pack.

Flow formulas . . . There are a great many formulas which have been developed from time to time for the solution of natural-gas-pipeline problems. A few popular ones can be mentioned. They are known as the Panhandle, Weymouth, Miller, Nikuradse, Biddison, and Ross formulas. They all have one term in common which is $(P_1^2 - P_2^2)/L$, and all other variables, such as specific gravity, mean flowing temperature, pipe diameter, empirical efficiency, and terms of the effect of compressibility, and friction factors, are carried out to different mathematical powers.

Other formulas, of course, are available in the literature. The recognized gas-flow formula has so many independent variables that ordinary mathematical solutions are rendered tedious and impractical, especially when a considerable number of solutions are desired. For that reason simplified procedures have been sought for some time, and there have been developed a great many tables of flow coefficients, squares and square roots, and correction factors, as well as various logarithmic charts, nomographs and other complex media to assist in solving the equations. Certainly the B. F. Grizzle slide rule is extremely useful.

For solving transmission-pipeline problems, however, the pressure distribution charts described in this article are especially useful.

Engineering application . . . Use of the pressure-distribution charts provides standard work sheets easily interpreted by the management and also simple permanent records of flow studies. As well as providing the mechanism for working the problems, it is a form suitable for final presentation. It can reduce the most complex flow problems to simple solution. The great speed with which problems are solved by this method can save enormous man-hours of work and provide immediate answers when urgently needed.

The simplicity breeds accuracy and eliminates numerical errors which are bound to creep into extensive computations. The very nature of the graphic presentation provides a visual check against error. The fundamentals of problems stand out in bold relief when line performance is delineated on the chart.

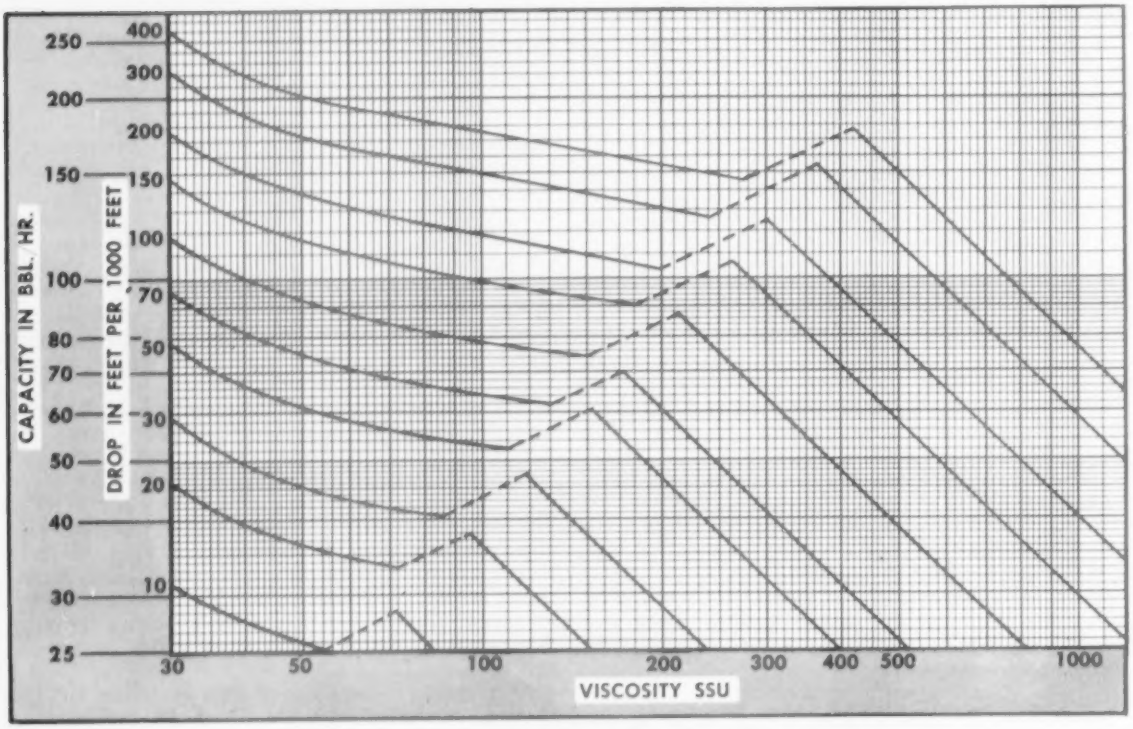
Benefits . . . The advantages mentioned above will accrue to those who use the system. Certainly, the few drafting hours invested in creating permanent flow charts, as well as the general distribution chart, is a very small thing compared to the man-hours saved and the good job derived from the use of the charts.

The graphic method is not elaborate, though at first glance it may seem so, because of the considerable explanation and examples which have been given here in order that the underlying principle may be surely grasped.

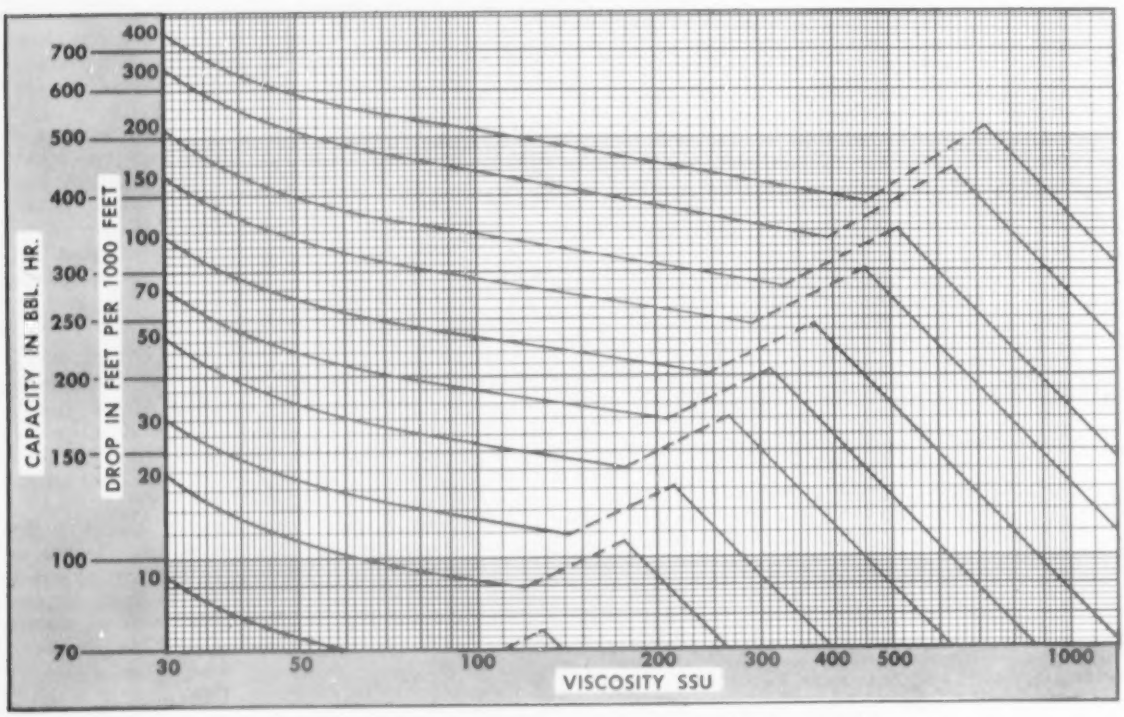
All in all, the pressure-distribution charts are not just another solution of the gas-flow equation, but they are a system of graphically presenting, solving, and interpreting natural-gas transportation-system flow problems. Use of the system will open many new vistas in problems of this nature.

Gas-Flow Analyzer

OIL-FLOW ANALYZERS . . .



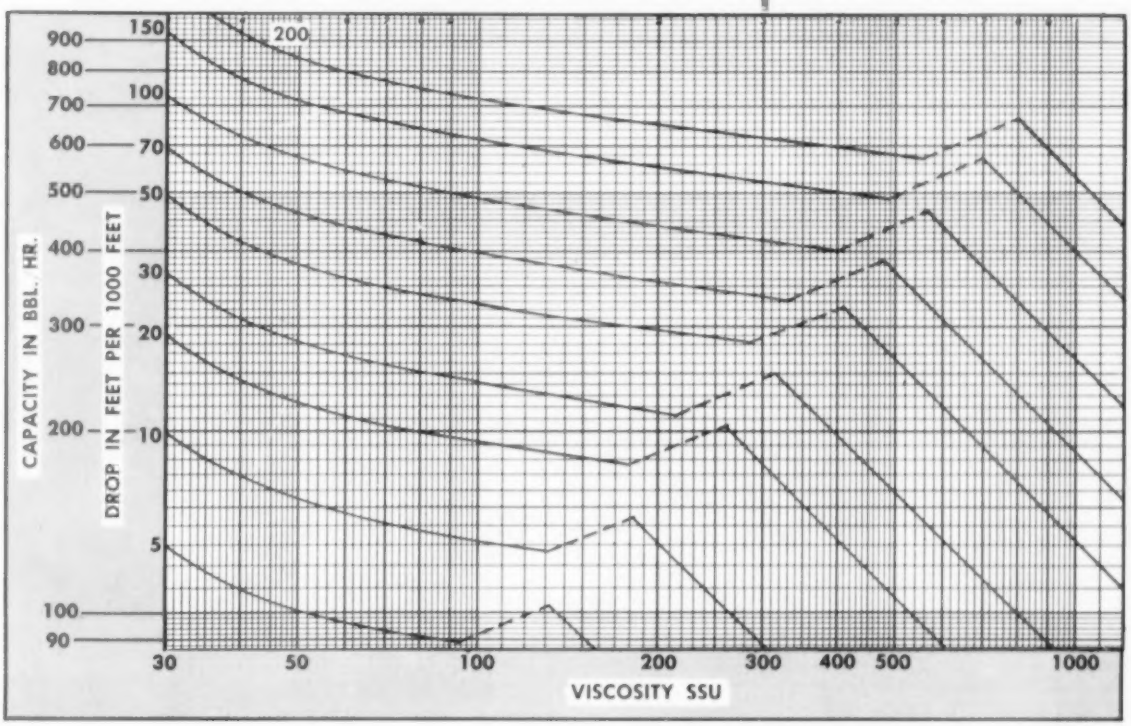
Capacity curve for 2-in. pipe, standard weight



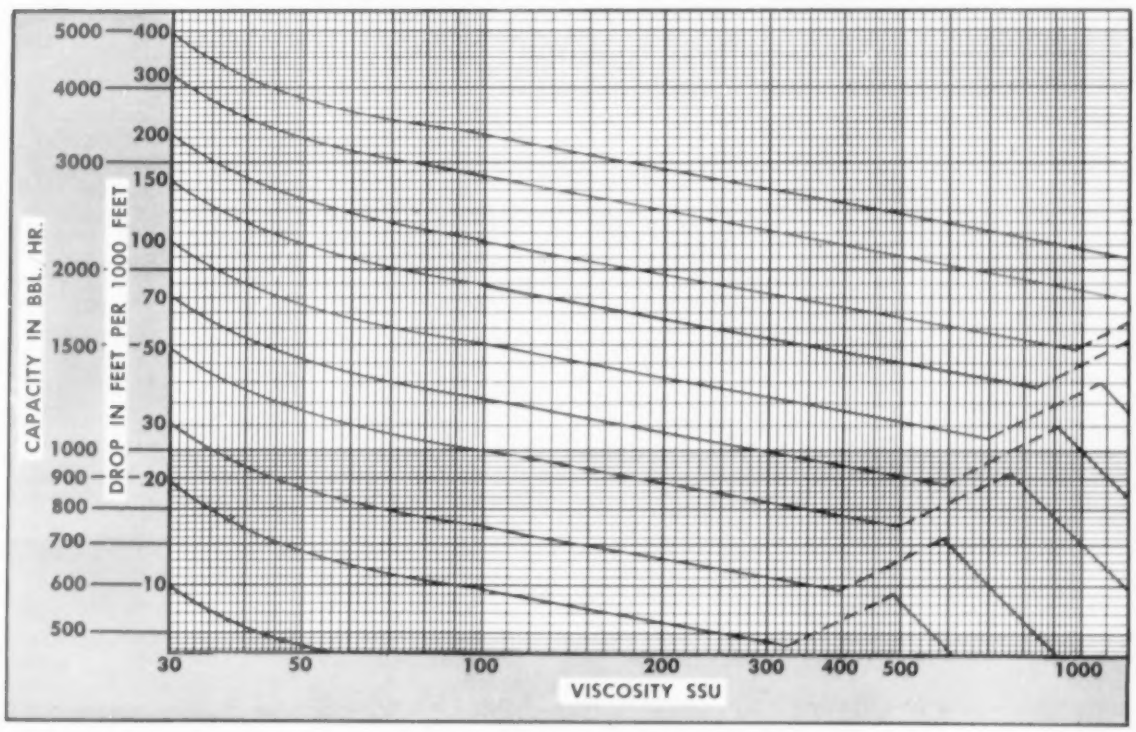
Capacity curve for 3-in. pipe, standard weight

On these two pages and the following page are six handy solutions for field problems, pipe sizes 2, 3, 4, 6, 8, and 10 inches. See sample solution on next page.

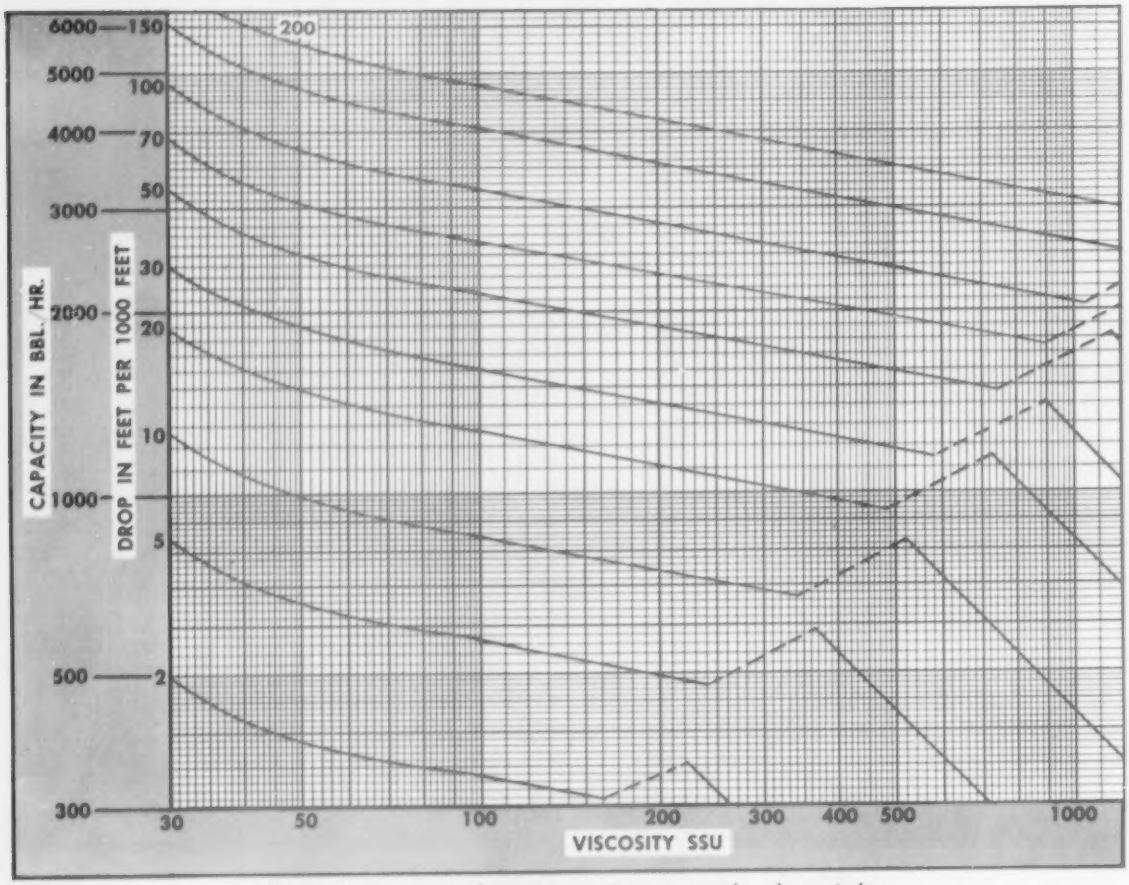
Charts developed by Service Pipe Line Co. Tulsa



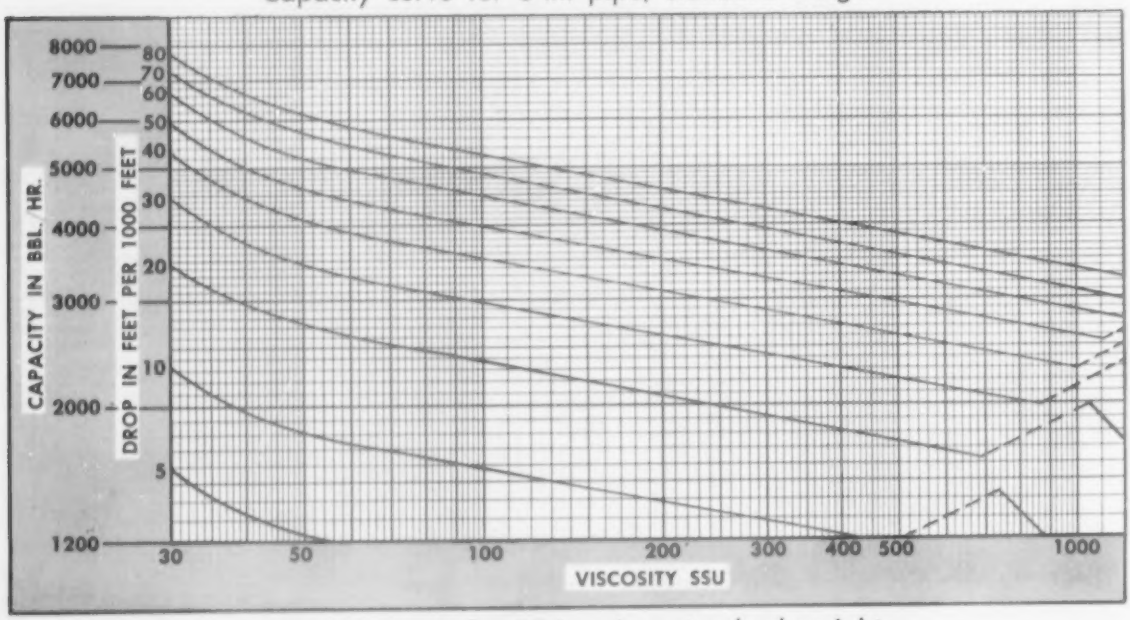
Capacity curve for 4-in. pipe, standard weight



Capacity curve for 6-in. pipe, standard weight



Capacity curve for 8-in. pipe, standard weight

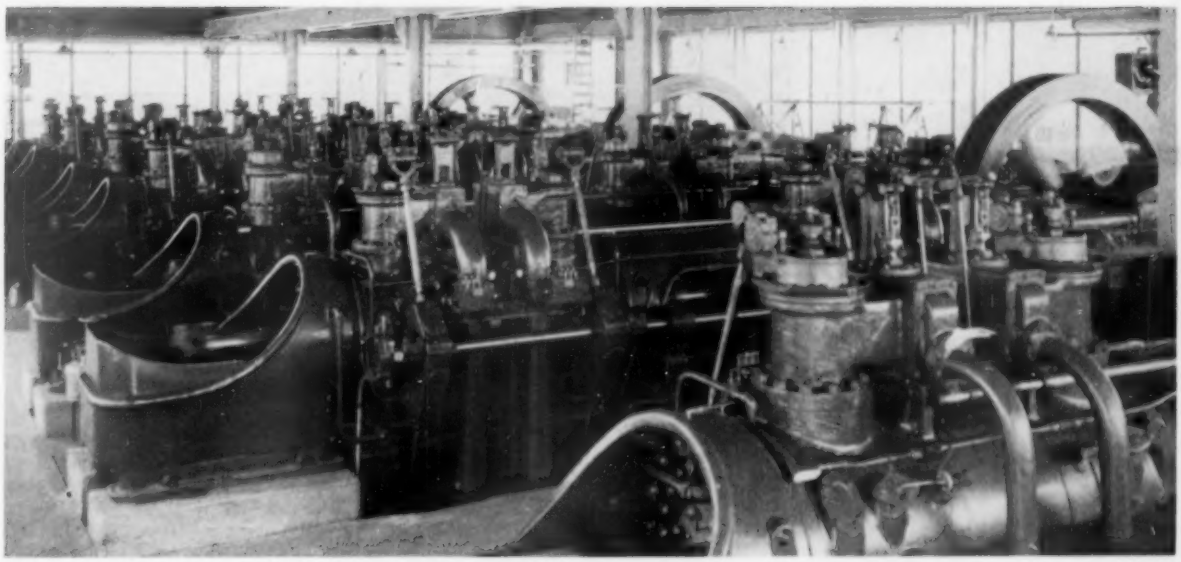


Capacity curve for 10-in. pipe, standard weight

SAMPLE PROBLEM

Given: 10-in. flow line with drop of 20 ft. per 1,000 ft. Viscosity equals 100 S.s.U.
Find: Flow rate in barrels per hour.

Solution: From 100 S.s.U. point on abscissa, proceed vertically to intersection with 20-ft. curve. Read capacity on ordinate, 2,370 bbl. per hour.



HORIZONTAL GAS ENGINES used to drive compressors at the Hooker station. Supercharging of this type engine raised power output 40 per cent. Fig. 1.

Renewed Vigor for Old Gas Engines

A 40 per cent increase in power output of a 1,250-hp. horizontal engine was the result of installation of an exhaust-driven turbocharger by Natural Gas Pipeline Co. of America. Fuel and power tests indicate real economies are thus possible.

by C. S. Kenworthy

AS a result of a conference with representatives of Worthington Pump & Machinery Corp., a decision was made in February of this year by Natural Gas Pipeline Co. of America to supercharge a 24 by 36-in. twin-tandem 1,250 - compressor - horsepower gas engine. A study by the Worthington's engineering department indicated that by using the Buchi or blowdown system of supercharging and a supercharging pressure of approximately 5 psi., we could expect a 35 to 40 per cent increase in load-carrying ability of the engine. Furthermore, there was reason to expect to operate the engine at 1,650 to 1,750 compressor horsepower without excessive operating temperatures and pressures.

The preparation of the drawings and the manufacture of the turbine-driven compressor as well as of the engine parts and piping was expedited by all concerned, and on May 28 a supercharged unit at our Hooker, Okla., station was operated for a few minutes on no load. Since that time this engine has been operated at 1,750 hp. or somewhat above, for a total of over 600 hours by the end of July.

The engine operates very smoothly with no indication that any of the various phases of the operation may prove to be troublesome in the future. Indicator cards taken on the power cylinders and on the exhaust piping, and exhaust-gas analyses taken through a timed sampling valve during the exhaust stroke, have demonstrated that the engine is operating with sufficiently lean mixtures. The lubrication of power cylinders and rods has been excellent, as evidenced by daily observation of the condition of the oil from the packing cases and from inspection of a cylinder and a set of packing. There was practically no carbon formation in the 600-hour period.

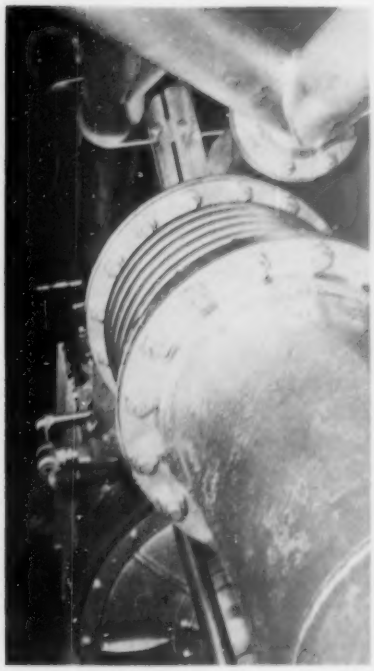
Unfortunately, an increase in the capacity requirements at the Hooker station has necessitated running the engine continuously, and we have been unable to conduct tests at other than the 1,750-hp. load and full speed of 125 r.p.m. However, a review of the methods used and the information obtained should be of interest.

The type of engine concerned is shown in Fig. 1, a photograph of the Hooker station where the tests on supercharging have been conducted. The power end of the units is on the left side of the picture. The compressors are to the right beyond the flywheels and do not show in the photograph. Each engine consists of two main frames and four double-acting horizontal cylinders placed symmetrically on either side of a flywheel.

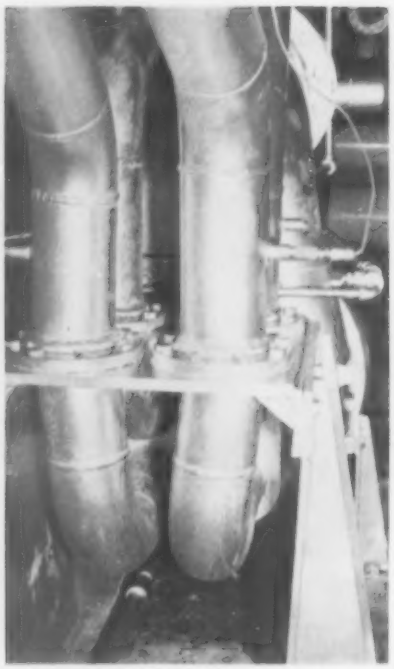
For convenience, the terms left-hand and right-hand will be used to designate the two sides of the engine and the two ends of each double-acting cylinder will be considered as separate cylinders (they are separate combustion chambers). The cylinders are therefore numbered 1, 2, 3, and 4 on each side numbering toward the flywheel. The No. 1 left-hand cylinder, shown in the right foreground with the standard mixing valve arrangement, corresponds to the rearranged equipment later described and shown in Fig. 3.

Engine modifications . . . The rearrangement of the engine for supercharging was accomplished as follows:

1. The turbocharger is located between the right and left-hand power



TURBINE AND BLOWER are installed in a pit below engine-room floor. Large pipe in foreground is the turbine exhaust and the pipe below it is the blower air intake. Fig. 2.



HOT EXHAUST GAS from engine cylinders enter the turbine through these 6-in. pipes. Small lines are for measurement of temperatures and pressures. Fig. 3.

cylinders below the engine-room floor level. The two No. 1 cylinders are piped together through a 6-in. Y-connection and thence through 6-in. piping to the turbine. The Nos. 2, 3, and 4 cylinders are connected in pairs in a similar manner. This results in four exhaust-gas inlets to the turbine nozzle ring.

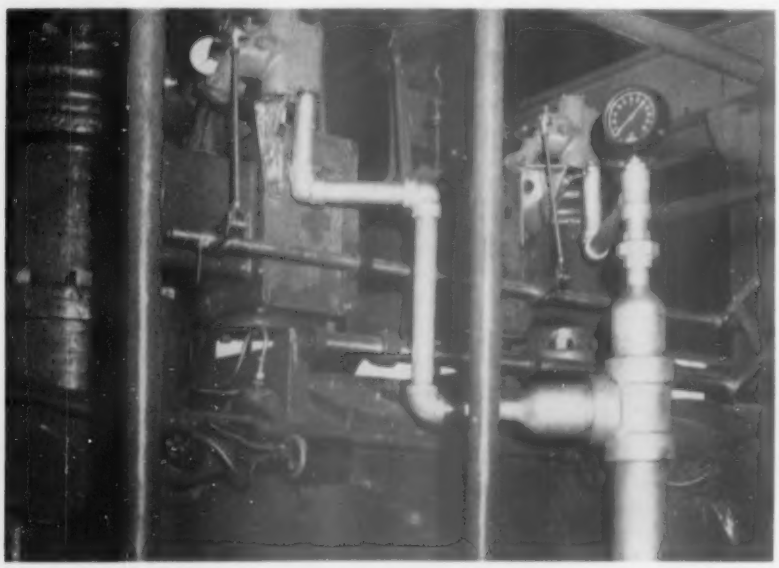
Each of these four exhaust-piping systems is entirely separate, i.e., the exhaust gas does not mix until after it passes through the nozzle ring. With the normal firing sequence wherein the No. 1 cylinder on the right follows by 90° the No. 1 left-hand cylinder, the entire advantage of the blowdown system would have been lost. However, by rotating one of the camshafts and changing the firing sequence so that No. 1 right-hand cylinder follows No. 1 left-hand cylinder by 450°, the back pressure which might have been created is eliminated.

Necessary rearrangement of the intake and exhaust piping was accomplished without much difficulty. Fig. 2 shows how the turbine is connected by means of a flexible coupling to the exhaust piping. The free-air piping entering the building on each side of the engine is connected together and thence to the blower underneath the exhaust piping as indicated in the photograph. The two 6-in. pipes from the No. 1 cylinders are in the top foreground. These "Y" into a common 6-in. pipe. The four 6-in. exhaust pipes to the exhaust turbine are clearly shown in Fig. 3. The photograph in Fig. 3 was taken from the opposite end of the turbo-blower from that in Fig. 2.

2. Each inlet valve casing was machined to receive a conventional-type, fuel-gas injection valve. The original arrangement included a separate gas-control valve attached to each injection valve. The control valves were operated through a control-shaft mechanism from the governor. Fig. 4 shows the arrangement on a No. 1 and No. 2 cylinder which was used on the supercharged engine. The injection valve for the No. 2 cylinder is in the top center of the picture. The control valve for this cylinder is immediately to the left of the fuel-gas pressure gage. The control mechanism for these valves, driven by means of a lever and link from the air-valve control shaft, is clearly shown.

This arrangement is being replaced with two control valves, each one supplying fuel to four injection valves. In addition, the area through the piping is being enlarged. These changes are being made to reduce the fuel pressure to suit the requirements of the station.

3. The injection of the fuel is accomplished by means of a lobe on the top of the combination inlet and exhaust cam, using a special inlet-valve fulcrum pin to support and actuate the injection valve. This special-shaped cam makes it unnecessary to use an additional cam and push-rod mechanism.



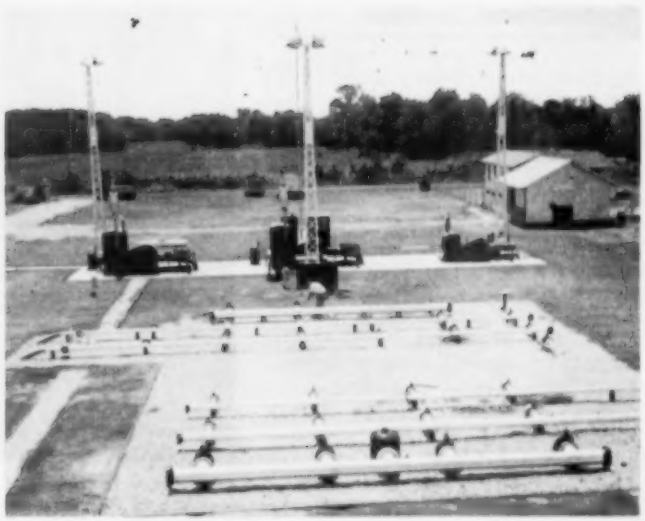
FUEL INJECTION VALVE and control valve mounted on the No. 2 engine cylinder. These valves are controlled by linkage to the air valve control. Fig. 4.

Test results . . . A typical indicator card of a supercharged cylinder taken with a 200-lb. spring is shown in Fig. 5. The corresponding card on a cylinder without supercharging is shown in dotted lines. These cards show better than any verbal description the difference in cylinder pressures.

The importance of rotating the camshaft to get the correct firing as previ-

(Continued on page 261)

HIGH-CAPACITY, long-life, nickel-cadmium batteries do a better job of starting large engines.



CLEANLINESS and order like that evident at this manifold and pumping station bring greater efficiency and fewer accidents.

Your pipeline operations will yield

More Gross Profit With Minimum Investment

...when you keep an eye on the "minor details"

by Alva C. Smith

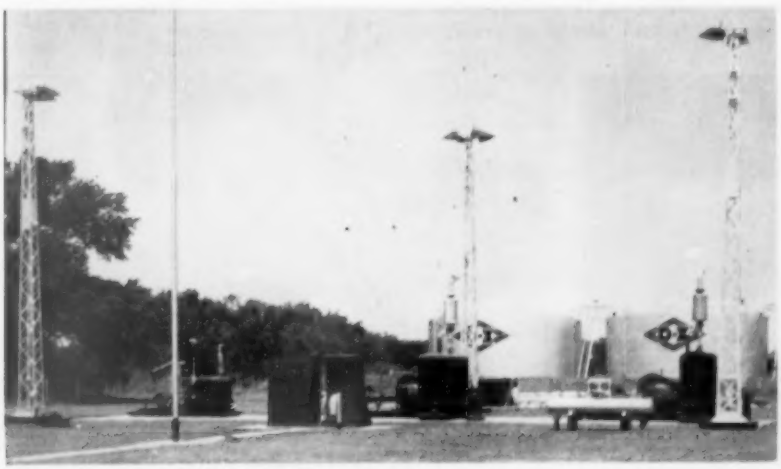
THE possibility of increasing gross profits with a minimum increase in capital investments is a definite reality—especially in crude-oil gathering operations. This potential field of endeavor has been partially explored, but the full potential of increasing gross-profit dollars by more efficient operation remains to be realized.

Strangely enough, the road to increased efficiency lies not so much in finding something new as in utilizing those time-tested methods which have not been generally applied. The first reason for not having generally applied these proved methods is probably their seeming insignificance. Secondly, during these years of extensive expansion, the emphasis has probably been placed on how best to spend expansion funds, rather than on how to earn additional gross-profit dollars.

Doubtless the emphasis will now shift to redoubled efforts to increase efficiency in crude-oil gathering systems. Specific examples are included in this discussion.

The very fact that we have experienced this unprecedented expansion of the pipeline industry, both in scope and application, is evidence of management's intent to render increased service and to reduce transportation cost. Consequently, the intense competition that now exists in trunk-line operations must inevitably extend to crude-oil gathering systems. In the author's opinion, intense competition for available dollars will yield high dividends when fully extended to gathering operations.

The opportunities for eliminating expense dollars are not particularly limited to crude-oil gathering operations; however, this discussion will be confined to eliminating operating and maintenance expense dollars. Irrespective of their source, expense dollars eliminated are gross-profit dollars made.



OPEN-AIR PUMP STATIONS have been made possible by use of such things as ceramic-insulated spark plugs and weatherproofed high-tension systems.

How to reduce expense . . . The follow-

ing procedures will serve as yardsticks for those charged with achieving these objectives as well as those who will be required to judge the results obtained:

1. Approved lubrication methods.
2. Approved housekeeping methods, or consistent cleanliness.
3. Approved routine-inspection methods.
4. Approved preventive maintenance.
5. Approved personnel education, as related to equipment, methods improvement, and preventive maintenance.

These are the basic factors or tools which, if applied, will result in reduced maintenance and operational costs. The significance of each factor is related to an efficient program as follows:

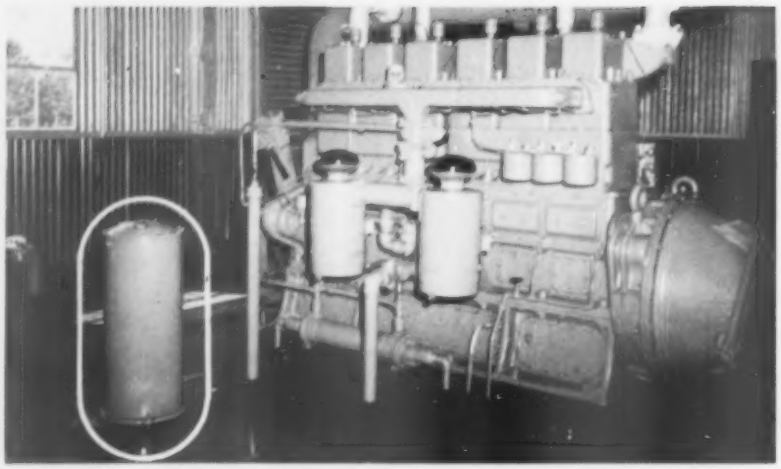
1. Low-cost operation of all machinery depends more on correct lubrication than on any other factor. This basic principle is fundamental to the successful operation of all machinery, without exception. An approved lubrication program will include the most efficient oil-filtration equipment and application methods available.

2. Consistent cleanliness is most important to any low-cost operations and maintenance program. In all matters related to mechanical equipment, economy begins and ends with cleanliness. Experience invariably proves that painstaking attention to cleanliness is found in those companies whose accident record is first rate.

3. An intelligent inspection program is the backbone of every worth-while operations and maintenance program. When equipment inspections are consistently and properly made, most of the little defects will be found and corrected before they cause prolonged shutdowns and expensive repairs. Every successful inspection and maintenance program begins when the equipment is installed and continues throughout the service life of the equipment. Special emphasis should be placed on routine inspection of all new equipment during the manufacturer's warranty periods so that any defective materials or workmanship can be adjusted by the manufacturers in accordance with their warranty.

4. Preventive maintenance is absolutely essential to any long-range program of efficient maintenance and operation. It must tend to simplify and eliminate maintenance problems as well as to maintain equipment. Special emphasis should be placed on such eliminative maintenance because the dividends are high.

5. Personnel education is the key to employe acceptance and unreserved cooperation in an efficient program. It is also excellent insurance against the risks involved in maintenance and operational procedures. Personnel must be thoroughly informed as to the ratings and intended use of equipment if it is to be operated with a minimum risk of personal injury and/or damage and loss of equipment.



THE RECORD PERFORMANCE of this engine—18,000 hours of operation without overhaul—proves the effectiveness of the author's plan of preventive maintenance and attention to detail. The encircled oil filter and close, automatic control of lube-oil and cooling-water temperature permit the engine to be run approximately 2,500 hours between oil changes.

Results of Such a Program

What are the results of a program aimed at ultimately eliminating a maximum of expense dollars? Let's look at specific and detailed methods by which this has and can be accomplished. To emphasize the fact that surprising returns can come from attention to seemingly unimportant mechanical devices, let's take the simple spark plug as our first specific example.

Ignition spark plugs . . . Most engine trouble is attributable to accessories, with ignition being the worst offender. Our investigations indicated that the primary cause of ignition trouble was attributable to spark plugs. Tests demonstrated that the average service life

(Continued on page 240)

ONE NICKEL-CADMIUM BATTERY is centrally located at this field gathering station so it can start all station engines.

STANDARDIZATION of this skid-mounted field pumping unit permits it to be moved easily and used at any of the stations.

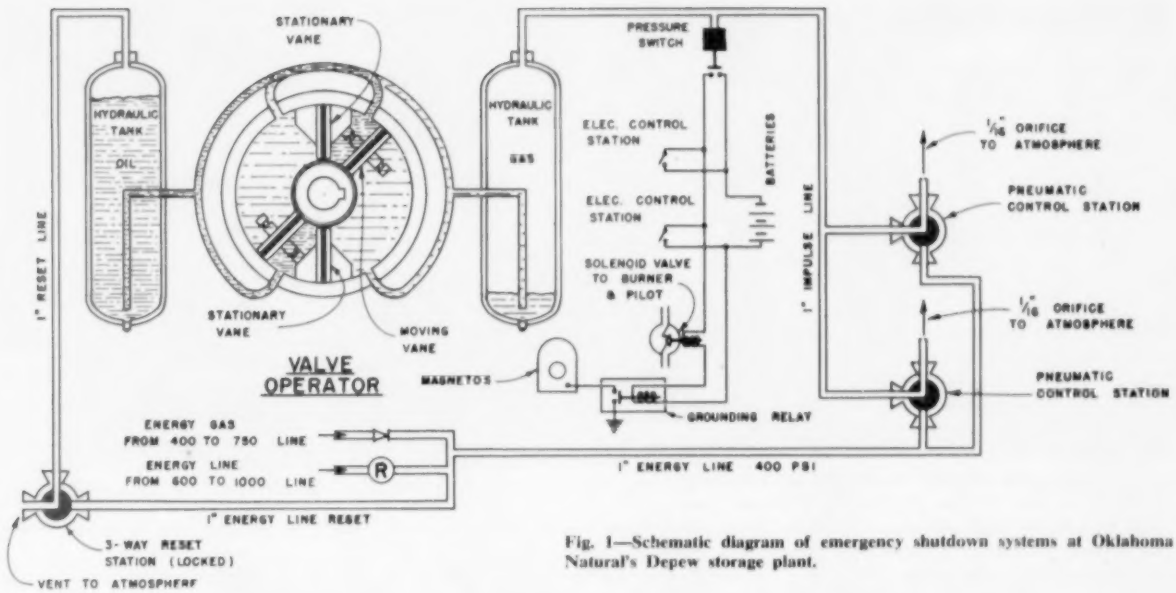


Fig. 1—Schematic diagram of emergency shutdown systems at Oklahoma Natural's Depew storage plant.

Double Shutdown Safeguards Storage

Two interconnected emergency systems reduce hazard to personnel and property at Oklahoma Natural Gas Co.'s Depew storage plant

by E. H. Parker

THE chief hazards in gas-compressor-station operation are mechanical failure in machinery, failure in gas pipes, and fire. Damage from machinery failure may be confined to that of the original break by immediate shutdown, while spread of damage from pipe break or fire can be avoided by quickly removing fuel from the area of the break.

The Depew storage is an important part of the Oklahoma Natural Gas Co. system. To avoid loss of the use of the storage, other than for a short period of time, the company planned the pipe system outside the plant area for continuous operation despite failure in any one section. The plant area, which comprises the compressor station, dehydration plant, measuring, and scrubbing facilities, is protected by two interconnected emergency systems:

1. An electrically energized relay system which will ground engine magnetos and shut valves at all gas burners. The electrical system may be placed in operation from any one of nine control stations which are located beside exits leading from the operating areas.

2. A pneumatic system, energized by gas pressure, which closes block valves on all pipelines to and from the plant, opens blowoff valves to remove all gas from the operating area, and trips the electrical system through a pressure switch, thus shutting down the plant and taking the storage out of service. The pneumatic system is placed in operation from either of two control points located at exit gates.

Author is staff engineer with Oklahoma Natural Gas Co., Tulsa.

The emergency systems were installed with the valves located so that the plant may be isolated and gas supplied from storage direct to the company's transmission system.

Electrical system . . . It was planned that an electrically-energized, remote-control system should be installed with control stations so situated that operating personnel, leaving the danger area, could trip a control which would shut down engines and close valves at all gas burners. This system will be used should there be a mechanical casualty to an engine which threatens to spread and which might be dangerous to approach. It will also be used in case of a failure in the dehydration glycol system or at any time a quick shutdown is required and it is thought unnecessary to blow gas from the area.

The electrical system was designed by A. A. Phillips, of Oklahoma Natural, and the equipment was supplied by Paul King Co., of Tulsa. Electrically operated valves were installed on all gas burners and pilot lights. Engine magnetos were connected through relays to ground. The electrical operators and relays are connected to nine control switches, any of which will complete the circuit. The energy for the circuit is supplied by batteries. A schematic diagram of the system is included in Fig. 1.

To start the plant after the electrical circuit has been tripped, it is necessary to manually place the control switch, which has been closed, grounding relay, and burner controls at reboilers in operating position.

Pneumatic system . . . A pneumatic shutdown control was designed by the writer when it was further decided to install a manually operated system which would shut gas out of the plant area and blow residual gas in the plant pipes to atmosphere.

This system is to be used should a major blowout or a fire occur in the gas-pipe system in the plant area.

Operations Section

Operations Section

Block valves were installed on the gas lines entering and leaving the plant with blowdown valves on the plant side of the block valves. The block and blowdown valves were equipped with pneumatic operators.

As shown in Fig. 1, gas pressure is supplied from two transmission lines entering the plant, one operating at 400 to 750 psi., the other at 600 to 1,000 psi. The full pressure of the low-pressure line is carried to the three-way control valves located at the plant gates. Should the pressure to the control valves fall to 400 psi., gas is supplied from the high-pressure line by regulator "R".

Gas from the control valve flows through a 1-in. impulse line to one of two hydraulic tanks located at each valve operator and to a pressure switch in the electrical emergency circuit described above. Which of the hydraulic tanks the impulse line is connected to is dependent upon the direction the operator and valve plug are to move, i.e., whether to open or close the valve.

The valves at the Depew plant are Nordstrom plug valves with Shafer Sentinel operators mounted directly on the valves. The Shafer Sentinel operator is a cylinder with two stationary vanes and one moving vane. The moving vane is keyed to the valve plug. Hydraulic fluid is forced by gas pressure from the tank to opposite sides of the moving vane, thus applying the torque to turn the valve plug.

Blowoff valves are located on the suction lines, the discharge lines, and the fuel-gas system.

Restarting . . . To start the plant after it has been shut down with the pneumatic system, it is necessary first to return the three-way control valve to its operating position which vents the impulse line to atmosphere, then to turn reset valve to reverse the valve operators. After the valves have returned to their operating position, the reset valve is turned to its original position which vents the reset line.

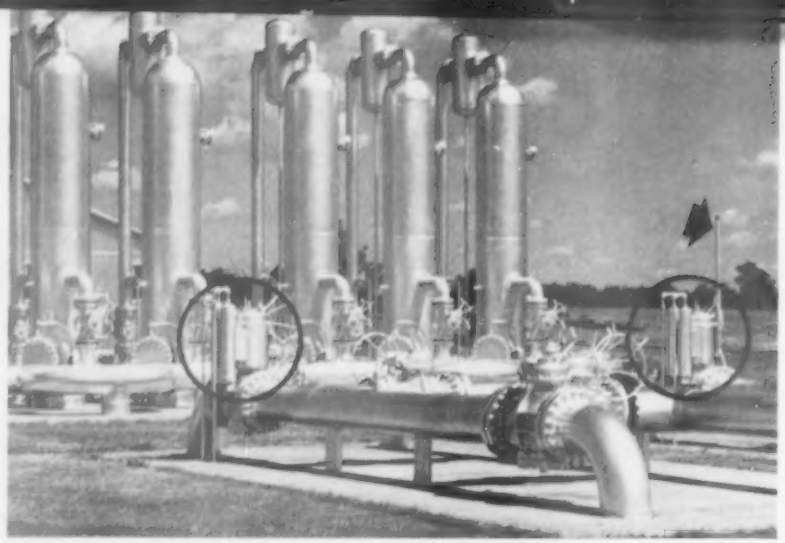
Following resetting the valves, it is then necessary to replace the electrical circuit in operating position and the plant is ready to start. To avoid accidentally resetting the valves following a blowdown, the three-way reset valve is padlocked in operating position.

Remote control of the emergency system was chosen for its simplicity in operation, maintenance, and testing. The pneumatic system, as the final and complete shutdown, was chosen for reliability. Company personnel are more familiar with pneumatic equipment than with electrical. It is impossible for the pneumatic system to operate accidentally other than through human error. The Shafer operator was chosen for its high torque and particularly because of the small amount of gas required to operate it, thus reducing possibility of freezing in the impulse lines.

Test results . . . On completing the installation and before keying the operators to the valve plugs, the system was tested and worked as expected. The operators were then keyed to the valves and a date set for test and to acquaint the operating personnel with the systems.

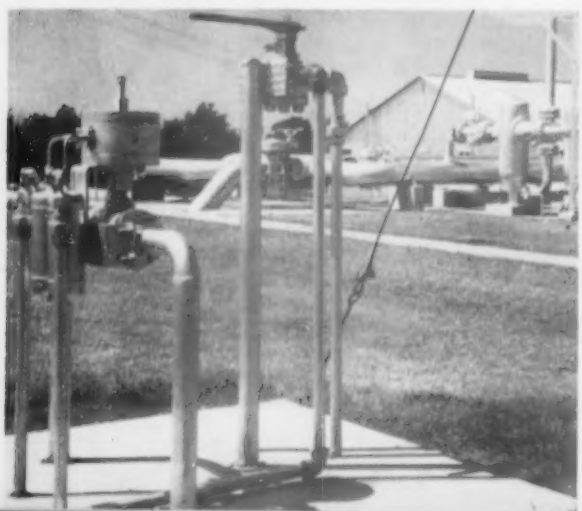
The emergency valves operate in 10 to 15 seconds, and the gas pressure blows off in 3 minutes. It was discovered that small, high-pressure plug valves may require an unusually high torque to operate them. Pressure to develop at least three times the rated torque should be supplied when they are used in a safety system.

The inspection interval has been established as 30 days. The systems are inspected visually and the valve operators and plugs moved manually to prevent them from sticking.

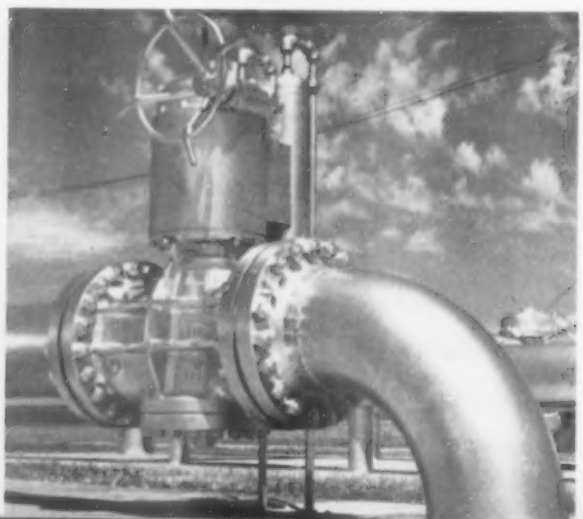


Power-operated block valves on incoming lines at the Depew storage plant. Arrow points to 12-ft. blowdown stack. This emergency system will blow down plant in about 3 minutes.

One control station for the pneumatically operated shutdown system. Two-inch valve at left is powered by Shafer operator.



Operator mounted on 16-in. plug valve. Gear case of similar valve without operator is visible, right. (Photos by Ruth Canady.)



THREE POSITIVE-DISPLACEMENT METERS for North Texas crude oil and four for Oklahoma crude oil at Ringgold station.

SCALES FOR CHECKING and calibrating meters by the gravimetric method before and after tests.

P. D. Meters Check Tank-Table Calculations

by O. D. Stallard, Jr. and T. K. Provence, Jr.

. . Toward Uniformity in Measurement

Man has always measured the world around him. In earliest times his body was his yardstick, his world demanded no accuracy, each man developing his own means and methods of measurement of which no standards were ever recorded.

The first known standards of measurement were established by advanced civilization along the Nile and the plains of Chaldea in the year 6000 B.C. The cubit became the prime standard of measurement in the year 4000 B.C. It was based upon the bent forearm of man from the point of the elbow to the tip of the middle finger of the outstretched hand. Roughly, this measurement was from 18 to 19 in., later standardized at 18.24 in.

In the early days, animal hides and earthen vessels of estimable capacity were used in the transportation or barter of fluids, grains, etc. The gourd was used to dispense of a given amount of water or soup; the larger the gourd, the more important the personage.

The history of weights and measures shows a slow but gradual improvement in methods of measurement throughout the centuries. The Office of Weights and Measures, originating in this country with the birth of the nation, was succeeded by the National Bureau of Standards in the year 1901. The bureau working with the representatives of each state have improved and standardized means and methods of measurement to a marked degree.

With the completion of the Drake well in 1859, the storage of crude oil became a major problem. This was solved in the field by building taper-type wooden tanks, with the staves held together by iron bands and iron tanks of larger capacities for station and refinery storage.

The taper type of construction of wooden tank created a problem for the producer in computing daily production. Robinson Brothers, observing this situation, realizing the necessity for accuracy in measurement, perfected their system of tank strapping, which, with certain modifications, is in use today.

Bolted and riveted steel tanks made their appearance in the oil fields in great numbers shortly after World War I, bringing out the necessity for uniform methods of measurement for tanks.

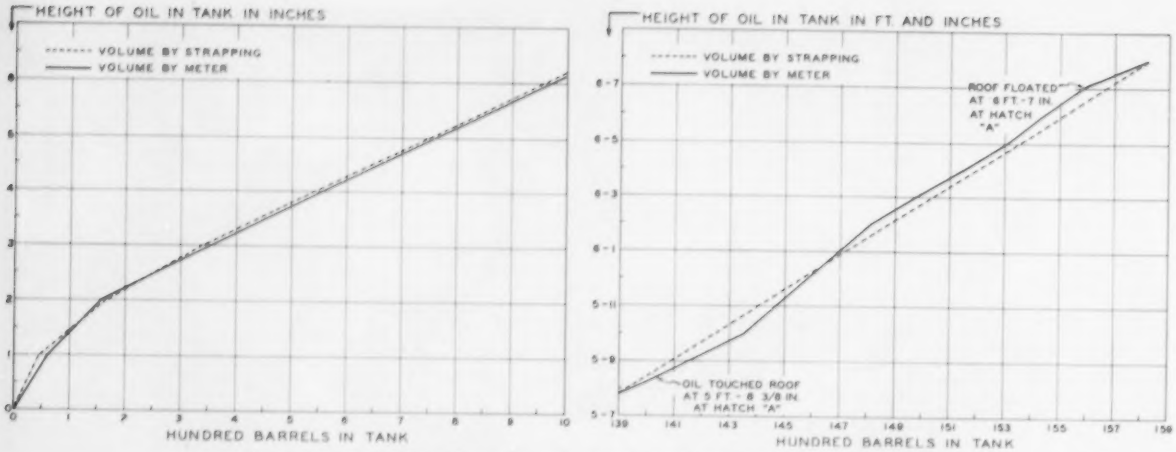
The American Petroleum Institute in 1928 authorized committees be formed to write a code based upon authoritative data, obtained by check strappings, for the measurement and calibration of all types of tanks, to to be known as Part 1, A.P.I. Code 25. At this time, Code 25 is being rewritten and should be ready for the oil industry early in the year 1955.

WITH the completion of three 120,000-bbl. pan-type floating-roof tanks at Magnolia Pipe Line Co.'s Ringgold station, the opportunity to check the tank-table engineer's calculations based upon A.P.I. strappings with positive-displacement meters presented itself. Oil is received at this station from North Texas and Oklahoma, through separate lines, separate meters, into one tank for a common stream.

The positive-displacement meter, designed in the middle of the nineteenth century, was used originally for industrial and domestic water service. Limited use in the oil industry started shortly after the turn of the century, with its popularity increasing year by year.

In recent years, as tanks have been constructed of greater capacities, there has been some feeling that further knowledge should be obtained to substantiate the method of computing volumes of tank bottoms and floating roofs as though they were true cone-shaped. The installation of positive-displacement meters at this location gave us the opportunity of being one of the first to be able to check the calculated capacity of large storage tanks with floating roofs by meter.

After each tank was tested with water and emptied, the pitch of the roof and bottom of tank were checked by instrument, and the underside measurements from bottom to roof were recorded along with other perti-


HEIGHT OF OIL IN TANK IN INCHES
VOLUME BY STRAPPING
VOLUME BY METER
HUNDRED BARRELS IN TANK
HEIGHT OF OIL IN TANK IN FT. AND INCHES
VOLUME BY STRAPPING
VOLUME BY METER
ROOF FLOATED AT 6 FT.-7 IN. AT HATCH "A"
OIL TOUCHED ROOF AT 5 FT.-8 3/8 IN. AT HATCH "A"
HUNDRED BARRELS IN TANK

Curves comparing the volumes by tank strapping and volumes indicated by meter.

nent data necessary for tank strapping.

Magnetic telephones were installed at the meter setting, the two gage hatches, and at the inspection well located near the center of the tank. The center inspection well was used to obtain a third measurement, along with the two gage hatches, as oil flowed into the tank. Gages were obtained by the use of three 10-ft. gage poles, until the roof floated; later hand line and remote-control gages were taken for the upper measurements. Communications were instantaneous, which made it possible for the three gage-pole readings and the meter totalizer to be read at the same time.

Rates of flow were controlled as far as practical, particularly at the critical points when the oil entered the tank, covered the bottom, touched the roof, and until the roof floated freely.

Meters were checked and calibrated by the gravimetric method prior to and after the tests. Through this procedure, calculation is made of the volume corresponding to the weight of the liquid in the weigh tank and compared with the volume registered on the meter. Accuracy of this method depends a great deal upon the accuracy of the scales and accuracy of obtaining A.P.I. gravity for converting pounds to barrels. The scales conform to the requirements of A.P.I. Code No. 1101, and the gravity of the crude oil is obtained by hydrometer. Tables are applied to convert this gravity at calibration temperature to pounds per barrel converting weight to volume. Meter factors are calculated to the nearest ten-thousandths (0.0001), and two runs obtained on each meter with a difference between meter factors not to exceed 0.0005 (0.05 per cent).

Curves on tank No. 2702 (see graphs) may be used to compare the volumes indicated by current operations method of tank strapping to the volumes indicated by meter. It will be noted that the bottom and roof of this tank as indicated by metered quantities compare very favorably on an average to the shape of a cone, as indicated by tank strapping. However, it may be further noted that from the time the oil touched the roof until the roof floated that the roof was continually changing shape to the extent that the volumes displaced were greater than and less than volumes displaced by cone.

On the second and third tanks checked, the volumes varied particularly on amounts covering the bottoms. Tank No. 2703, the second tank, showed metered volumes in excess of strapping volumes, while tank No. 2704, the third tank, indicated strapping volumes in excess of metered volumes.

On the latter tank, the flow rate was higher than desirable as the oil approached the crown of the bottom. This produced a sloshing effect, and it seems probable that there was an error in taking this exact gage. In calibrating a tank of this diameter, it is believed that flow rates should be maintained under 600 bbl. per hour as the bottom is filled and from the time the oil touches the roof until the roof floats.

As the tanks continued to fill after the roofs floated, the fluctuations in the differences between tank strapping volumes and metered volumes at various points seem to indicate that there was an irregularity in the rate of ascension of the roofs. If this were the case, the gages were affected as the oil heights varied in relationship to the extent of the variation in the immersion of the roofs.

In attempting to compute the weight of the roofs through the use of additional transit measurements, measurements at varied radii of the roofs, and volumes indicated by meter, we did not approach what we considered a good degree of accuracy.

Since this is a relatively new project, there are many data, as yet, unavailable. However, through practical pursuit of improvements in methods and the continued cooperation of all interested persons, it is believed that the calibration of crude-oil tanks by positive-displacement meter will be a progressive step in the field of measurement. From the information at hand, it does not appear to us that calibration of large tanks by meter, all or in part, will ever replace measurements as now taken by the tank strapper. It will be the means, however, of checking these measurements and improving the strapping of tanks.

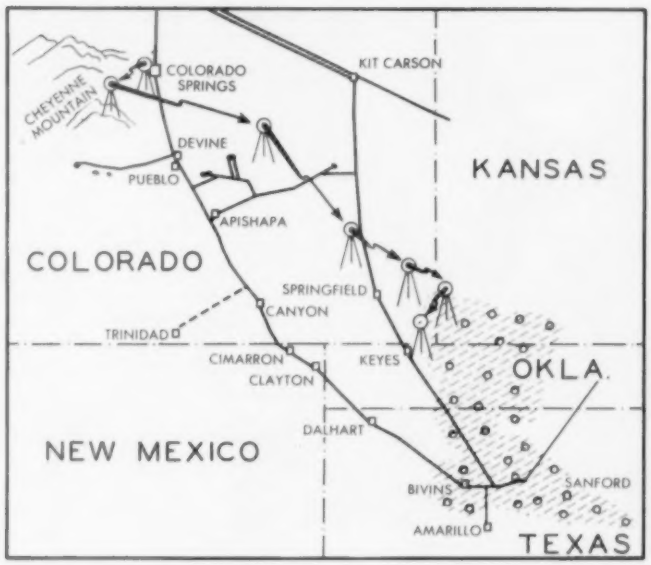
THE AUTHORS

STALLARD

PROVENCE

O. D. Stallard, Jr., division superintendent, Magnolia Pipe Line Co., Dallas, entered the employ of Prairie Oil & Gas Co., pipeline department, Illinois division, in February 1910, spending the next 8 years as a telegraph operator, stock gager, district clerk, oiler, and engineer. For the past 35 years he has been employed by Magnolia Pipe Line Co. as district gager, chief gager, superintendent of gagers, and division superintendent with headquarters in Dallas.

T. K. Provence, Jr., is a mechanical engineer assigned to assist operating personnel of Magnolia Pipe Line Co. in the installation, operation, and maintenance of meters.



THE MICROWAVE ROUTE passes over mountains and prairies alike in its 230-mile swing from Colorado Springs to gas fields in Kansas and Oklahoma.

FROM THIS POINT on Colorado's Cheyenne Mountain, the microwave beam is relayed 81.5 miles to next repeater station.

Colorado Interstate engineers considered various communication media, and . . .

Here's Why They Chose Microwave

by W. I. Blount

Extensive studies of other-type communication facilities indicated that microwave was best suited for long-distance communication by Colorado Interstate Gas Co. Despite long hops, weather extremes, and dust storms the system has performed adequately—justifying its choice.

A microwave communication system, extending 230 miles southeast from Colorado Springs, Colo., has recently been installed by Colorado Interstate Gas Co. The system connects the home office with pipeline compressor stations and with gas-producing fields in Kansas and Oklahoma. The microwave equipment operates in the 2,000-megacycle band and the system path is broken into six links, the longest of which is 81.5 miles.

Despite the fact that the path crosses mountainous country, areas where heavy dust storms prevail, and flat, fade-conducive terrain, no serious outages have occurred and the general operation has been very satisfactory.

Choice of microwave for this communication system was made only after extensive studies had been made on other available means of communication. Construction of a wire-line system was considered, as well as the leasing of common-carrier facilities. Both of these were discarded from a standpoint of economics and reliability.

When we first learned that the company would be operating compressor stations, pipeline construction and maintenance camps, and gas-producing fields, all in remote areas far removed from Colorado Springs, we began an engineering study to determine the type of communication that would be best suited for those operations. The stations, camps, and fields were located in southeastern Colorado, southwestern Kansas, northwestern Texas, and the Oklahoma Panhandle and it was mandatory that we have regular communication to and from such places. The communication system would terminate in our Colorado Springs office and would be used principally for operating and accounting purposes.

Wire line unsuitable . . . This company had a similar problem in 1947 when it constructed a wire-line system from Lakin, Kans., near Garden City, to Denver, a distance of approximately 298 miles. In the operation of this line, it was learned that maintenance was difficult because of the isolated areas plus the fact that frequent dust storms generated static which played havoc with communications. During the spring season the lines were put out of service once or twice a day by the nest-building activities of crows. It also was discovered that the addition of more channels was expensive.

Since the circumstances were very similar, we knew that construction of a wire line in the new area would occasion the same difficulties. There also was the problem of establishing telephone crews at suitable places to maintain this line adequately. The economics of maintaining such crews did not appear practical.

Reliability a big question . . . Common

(Continued on page 258)

Operations Section

MAIN TERMINAL point of Transco's 1,780-mile system is marked by this 300-ft., self-supporting tower located in downtown Houston.

TYPICAL parabolic antennas at a Transco repeater station. Solid 6-ft. "dishes" are used throughout the system.

How Transco Maintains 1,780 Miles of Microwave

by Robert H. Buechner

THE microwave system of Transcontinental Gas Pipe Line Corp. is approximately 1,780 miles in length and has roughly 9,350 circuit miles in use, all of which are for voice conversation. The main system consists of 59 stations placed at an average interval of 30.7 miles, with the shortest hop being 10 miles and the longest 50 miles. Tower heights range from 50 to 350 ft.

The backbone equipment operates in the 2,000-mc. band and utilizes pulse-time-division multiplexing. As installed, this equipment is designed to accommodate 12 voice channels, each having 3-kc. band widths. At four intermediate points all channels are demodulated and either terminated or wired through to modulate a new pulse train.

Spur circuits operating in the 950-mc. band are used to tie the main system to operational points located short distances from the pipeline. This system is used to provide communications essential to the maintenance and operation of a 30-in. high-pressure gas pipeline which runs from southwest Texas to New York.

The basis of any maintenance program is the field personnel; the effect these people have on service continuity approaches that of the equipment used. Since experienced microwave maintenance personnel usually are not available, these men must be trained. We of Transco believe that training can be accomplished in a period of 6 months to 1 year depending upon the attitude and aptitude of the individual involved. An experienced technician can generally acquire sufficient knowledge in 2 to 3 months to keep a circuit working at something less than maximum efficiency.

In selecting personnel it is important to secure men with a pioneering spirit as well as the requisite technical ability to absorb instructions. The former is very important since the microwave industry is essentially in its infancy and microwave techniques are still fluid and subject to rapid change. To further emphasize the importance of personnel, it is our belief that a system with poor equipment and good personnel will operate more satisfactorily than a good system with poor personnel. In any event an extended system is no better than its weakest man.

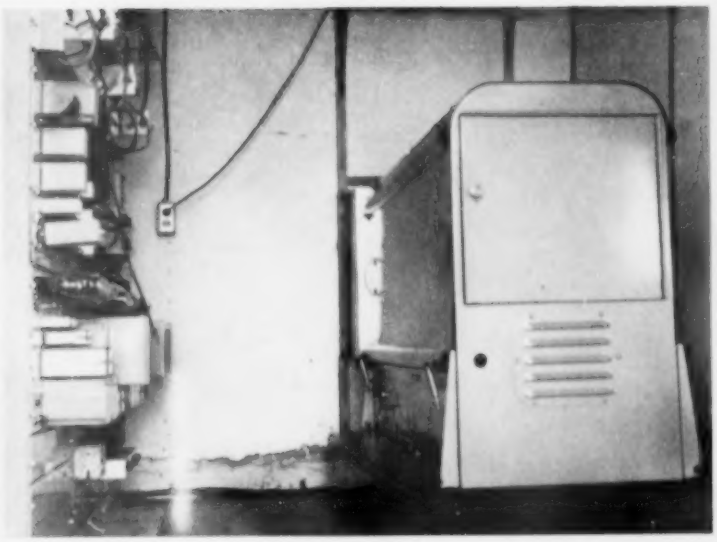
Maintenance districts . . . We have 15 communications maintenance men assigned to districts in the field. These districts usually include four stations and are spread out over a distance of 120 miles. Most districts include one or two stations with multiplex equipment, (points at which one or more channels can be demodulated and connected to company telephone facilities) and two or three microwave repeater stations. The average district includes 12 two-way mobile radio units although the concentration is heavier in the gas-gathering and sales areas than along the middle of the line. These men are also responsible for the maintenance of the electrical equipment at our compressor stations.

In an operation such as Transco's, distance is of the essence. For this reason it is desirable to increase the duties of the maintenance men in a given area and to decrease the size of the area. The ability of a maintenance man to plan his work efficiently is a great asset. The man who can spend the largest percentage of his time doing actual preventive-maintenance work at his stations and the least amount of time driving up and down the highway will do the best job. Our maintenance records show a definite correlation between outage time and automobile mileage for the various men.

In addition to the 15 men assigned to districts we also have 1 man who is free to work at any point on the line. His time is spent in training new personnel, vacation relief, and new construction projects.

In the design of a long microwave system, allowances are made for the cumulative effect of random noise. These allowances are based on average or normal operating conditions. Many simple deviations from normal conditions can and will occur, for example, a simple misadjustment of intermediate audio levels. This will degrade the operation of a long system where possibly the same condition would not be

FIFTY-NINE repeater and terminal stations contain over 8,000 replaceable vacuum tubes.



AUXILIARY POWER equipment is a continual source of trouble, principally because of dead batteries and inoperative power relays and cutouts.

Operations Section

noticeable on a shorter installation. This means that more attention must be paid to small details on a long system.

In maintenance, emphasis is placed on continuity of service from end to end, which makes it difficult to schedule any interruption in service for maintenance. During the summer months our system transverses through two time zones which causes an extremely heavy conversational load during working hours common to all parts of the system. Standby equipment permits tuning to be done while the equipment is not in service. However, we must constantly emphasize the importance of continuity of service.

Tube selection . . . The vacuum tube's importance to system performance is second only to personnel. On our system we have approximately 8,000 active tube sockets. Assuming an average life expectancy of 6 months we can expect two tubes to fail each hour. If complete failure actually occurred at this rate our maintenance personnel could never change tubes fast enough to keep the circuit operating. Fortunately tubes generally decrease gradually in emission and gm (mutual conductance) and can be detected and removed from service before degrading system performance.

Our primary concern with tubes has been the poor quality control by the manufacturers. Generally, identical tube types show variations in characteristics. We have not been able to conclude that any particular tube manufacturer's product was appreciably above or below the average when all tube types were considered. However, there are some tube types which apparently give particular manufacturers trouble on occasion. There are also types in which a particular manufacturer appears to hold a slight edge over competition. We try to take advantage of this by excluding a manufacturer's type of tube in which we feel they are below average, and by specifying a manufacturer's tube in a type in which it excels.

Unfortunately this is not always consistent, but varies from one production run to another. However, we feel that by exercising discrimination in our purchasing we will tend to improve the over-all quality control.

It is common knowledge that a sizable percentage of tube failures occur during the first few hours of operation. Some communications systems have a program of purchasing preaged tubes which are offered by a few manufacturers. Others preage their own tubes before using and reject those not meeting their requirements.

HEAT and dust in equipment shelters such as this pose a major problem for microwave maintenance technicians.

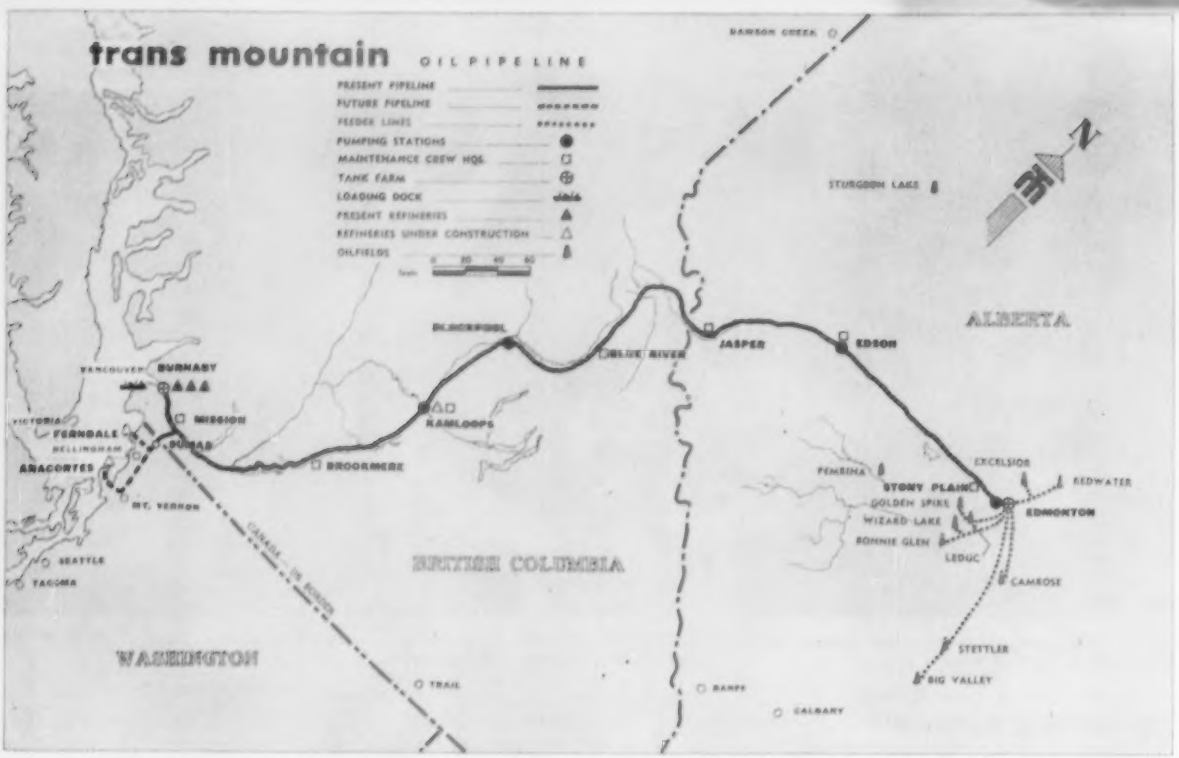
Ruggedized tubes justified . . . Although we are not currently aging our own tubes, we do use the premium heavy-duty, ruggedized versions of those tube types that are available. We have only been doing this on a large scale for a few months, so our experience is still somewhat limited. When we started experimenting with these tubes last November, we replaced all of the 12AT7 and 12AU7 tubes in our Houston station. Half were replaced with new 12AT7 and 12AU7 tubes and half were replaced with the premium equivalents 6201 and 5814A respectively.

By March we had replaced 12 of the standard tubes and only 1 of the premium tubes. This ratio of the rate of failure seems to be continuing. On this basis there is no question about the premium tube types being worth the additional cost. When the reduction in the probability of an outage due to tube failures is considered, the premium tubes have an overwhelming advantage.

Whereas, the premium tubes offer a distinct advantage for communication systems they are only available in a limited number of tube types. Another method of improving the tube problem is to keep accurate records of the frequency and causes of failures and make this information available to manufacturers. In some instances this has enabled the manufacturers to make small changes in construction which result in a materially better tube.

A considerable amount of literature has been written on the subject of

(Continued on page 260)



THE MAIN LINE of Trans Mountain's system extends 715 miles from Edmonton, Alta., to Vancouver, B. C.

Trans Mountain Completing Its First Year

Despite a hard winter, heavy erosion, many landslides, and stretches of almost inaccessible right-of-way, Trans Mountain's successful operation indicates a well-designed, built, and operated line that is a credit to its planners and managers.

by A. F. Terrill

BELYING the grave fears and pessimistic opinions that were held in some quarters during the construction period, Trans Mountain Oil Pipe Line Co. has now completed more than 9 months of satisfactory operation. The main line of Trans Mountain is of 24-in. diameter and extends 715 miles across the Canadian Rocky Mountains from Edmonton, Alta., on the prairies, to Vancouver, B. C., on Pacific Coast.

The line was built during 1952 and 1953 and gained considerable publicity during that period because of the difficult mountainous terrain along the pipeline route. It was thought by many that serious operating and maintenance problems would be encountered because of the weather extremes normal to the area. However, such has not been the case.

Typical winter, '53-'54 . . . During the first year of operations, the weather throughout the area traversed by the line was about average. Temperatures in the Jasper, Alta., area were as low as 42° F. below zero and those in Vancouver dropped to 10° F. above zero. Snow depth in the Blue River area averaged 4 to 5 ft. While the total fall of snow for the winter in the famous Coquihalla Pass was more than 50 ft., the actual depth of snow at any time did not exceed 6 ft.

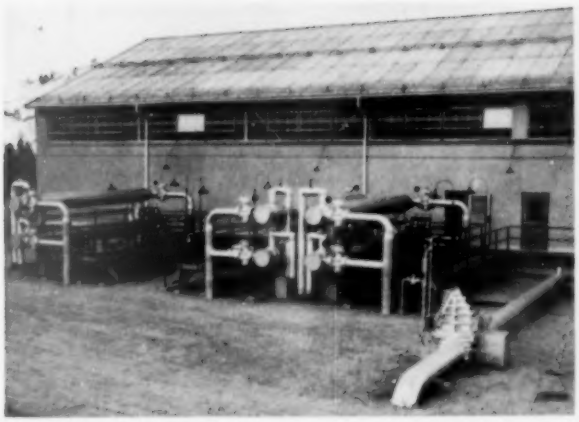
The heavy rainfall, and especially the spring runoff from the heavy snows, caused erosion, slides, and stream diversions which endangered the pipeline, but prompt action by maintenance crews took care of all threatening situations.

Maintenance crews . . . Because of the exceptional topographical features of the route, six pipeline maintenance crews are located strategically at Stony Plain and Jasper in Alberta, and at Blue River, Kamloops, Brookmere, and Mission in British Columbia.

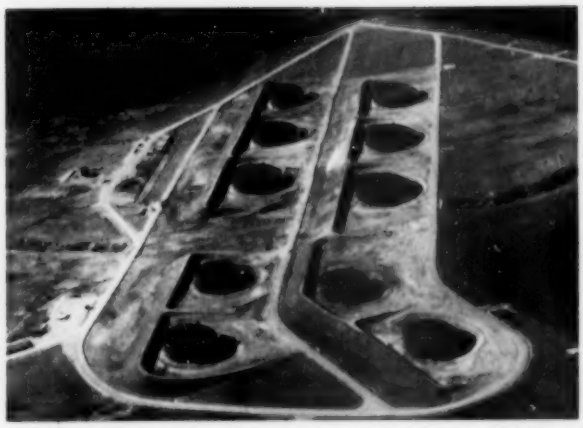
The principal work required of these crews thus far has been right-of-way stabilization in the passes of the Rocky Mountains and foothill areas. Through some of these passes, the rivers, railroads, and public roads have left a poor choice for the pipeline location—with the result that the spring surface water runoff caused numerous minor washouts of the right-of-way. These have been brought under control by dams, cribbing, piling, etc.

The number of leaks in the system have been few, and the quantity of oil lost has been very low. Six leaks, thought to be a legacy from construction, have been discovered. Four of these were pinholes in the circumferential welding, and one was a 1½-in. split in a longitudinal weld. The sixth and most serious was the failure of a weld where a 4-in. connection had been made to the main line for hydraulic testing. This leak occurred October 13, 1953, 2 days before the official opening at the Burnaby tank farm, and prevented the oil from arriving at the

Operations Section



INTERCOOLERS for engine cooling water occupy the center of this outside view of the Kamloops Pump Station building.



GIANT TANKS at Burnaby tank farm near Vancouver, B. C., store Alberta crude awaiting transfer to nearby refineries.

tank farm simultaneously with the opening ceremonies.

No roads for 160 miles . . . The route of this pipeline is not without its challenges to the operator inasmuch as it includes 72 stream and river crossings and two 80-mile stretches through the mountains that have no roads. The local trails that do exist are frequently blocked out during the winter months by heavy snowfall. Fortunately, the railroads traverse these sections.

Perhaps the most difficult problem in operation and maintenance is the transportation of personnel and heavy work equipment. Because of route conditions, all maintenance crews are equipped with a variety of four-wheel-drive vehicles, including Dodge power wagons, FWD trucks, and some form of snow transportation. Some of the latter are not only for travel on snow but also through muskeg areas. Certain crews also have heavy-duty tractors and backhoes.

Two railway units—each consisting of a heavy-duty flat car and a sleeping-dining car—are located at railway division points, readily available for movement to any area where such services are necessary. They are now being used as camps in isolated areas where crews are performing extraordinary maintenance work.

Tank farms, pump stations . . . Surface stabilization at the Burnaby tank farm and the Westridge loading dock near Vancouver posed some difficult problems due to topography and soil conditions. Some fire walls were not completed until late in 1953. This did not permit seeding as was done on walls finished earlier in the year. The frequent heavy winter rains damaged some of these walls to the extent that extensive repairs were necessary. The surface water drainage system at Burnaby proved inadequate and required both repairs and additions.

Pump-station operations throughout the period have been highly satisfactory. Low temperatures at Edmonton, Alta., of 38° F. below zero and at Kamloops, B. C., of 26° F. below zero did not cause any unusual difficulties. Operations were normal throughout the winter.

Helicopter patrol . . . Trans Mountain's line is patrolled by helicopters for a number of reasons. Before selecting this type of aircraft, trial flights were made by both fixed-wing planes and rotor aircraft. It was found that while a fixed-wing plane can operate satisfactorily in the prairies and Fraser Valley areas, flights through mountain passes were either impossible or too hazardous during much of the year. Also, such planes were not adaptable to efficient navigation of the thousands of abrupt changes of line plan and elevation.

Therefore, a contract was entered into for helicopter service, with patrols covering the entire line from a base at Kamloops. This location makes the helicopter available for extra patrol in the areas where earth slides and river diversions are most likely to occur. The helicopter is also used for carrying personnel in when emergencies arise.

THE AUTHOR

A. F. Terrill is vice president and general manager of Trans Mountain Oil Pipe Line Co. with headquarters in Vancouver, B. C. Before joining Trans Mountain on September 1, 1952, he was area manager of Shell Pipe Line Corp. in West Texas and New Mexico. He has been a pipeliner for more than 35 continuous years.

Communication facilities . . . Communications between dispatchers, tank farms, stations, pipeline maintenance headquarters, and field crews is effected by telephone and teletype circuits and dual-frequency radio channels, with nearly every installation having at least two of these facilities. The prime channel is a two-wire copper telephone circuit between Vancouver and Edmonton, specially erected by Canadian National Telegraphs and operated under a lease arrangement. The portable field phones which clip onto this telephone line have been particularly valuable.

Teletype facilities also are leased from Canadian National Telegraphs and the personnel of that company have invariably paid close attention to restoring service after interruptions.

Perhaps a major reason that no serious disruption of operations has occurred is the reliability of the communication system. At times each channel of communications has been disrupted, but at no time has the pipeline been without some form of communications. This has enabled speedy distribution of information, thereby permitting necessary orders, instructions, reliefs, movements of reserves, etc., to be made with a minimum delay.

Tribute . . . Looking back on the first 9 months of operation of the Trans Mountain oil pipeline, it must be concluded that the designers, constructors, and operators of this project planned well for its operating success. Thanks to a far-sighted board of directors which encouraged and obtained whole-hearted cooperation between those who were building the line and those who would operate it, serious problems of transition and second guessing have been nonexistent.

Operations Section

THIS OVER-ALL VIEW of Permian Basin's plant shows the MEA contactors at left, the still in the center foreground, and an aerial cooler at right.

New Plant Licks Pipeline Gas Problem

...successfully treats gas containing 30 per cent CO_2

by A. L. Vaughan and R. B. McLaughlin

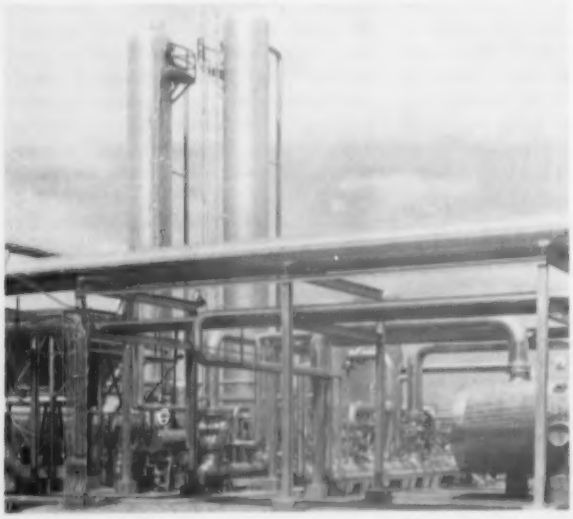
PERMIAN Basin Pipeline Co., a subsidiary of Northern Natural Gas Co., is presently operating, in Pecos County, Texas, a processing plant for conditioning natural gas containing approximately 30 per cent carbon dioxide. This plant, designated as Mitchell carbon dioxide removal plant, is believed to be the first installation constructed for the purpose of removing so large a percentage of carbon dioxide in order to render natural gas suitable for main-line transmission use. At design capacity the volume of carbon dioxide removed is approximately 9.8 million cubic feet per day or 1,100,000 lb. per day.

Due to the high carbon dioxide content, the gas as produced in the Pecos County area has a heating value of approximately 725 B.t.u. per cu. ft. By processing, to remove this carbon dioxide the heating value is increased to approximately 1,030 B.t.u. per cu. ft.

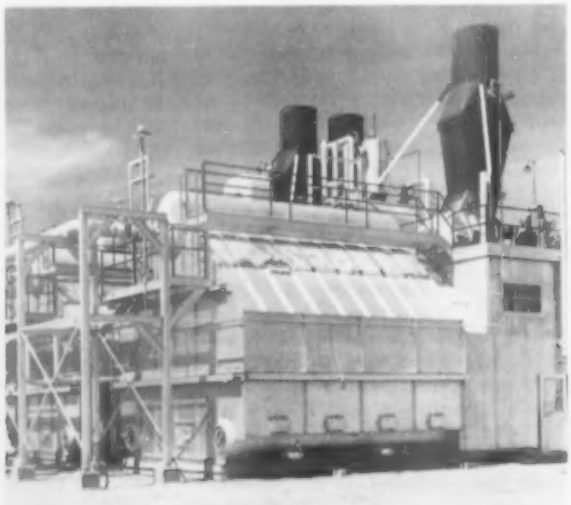
Operations Section

The plant was designed and constructed by Stearns-Roger Manufacturing Co., Denver. Design capacity is 25 million cubic feet per day of residue gas. However, piping facilities for an ultimate

(Continued on page 254)



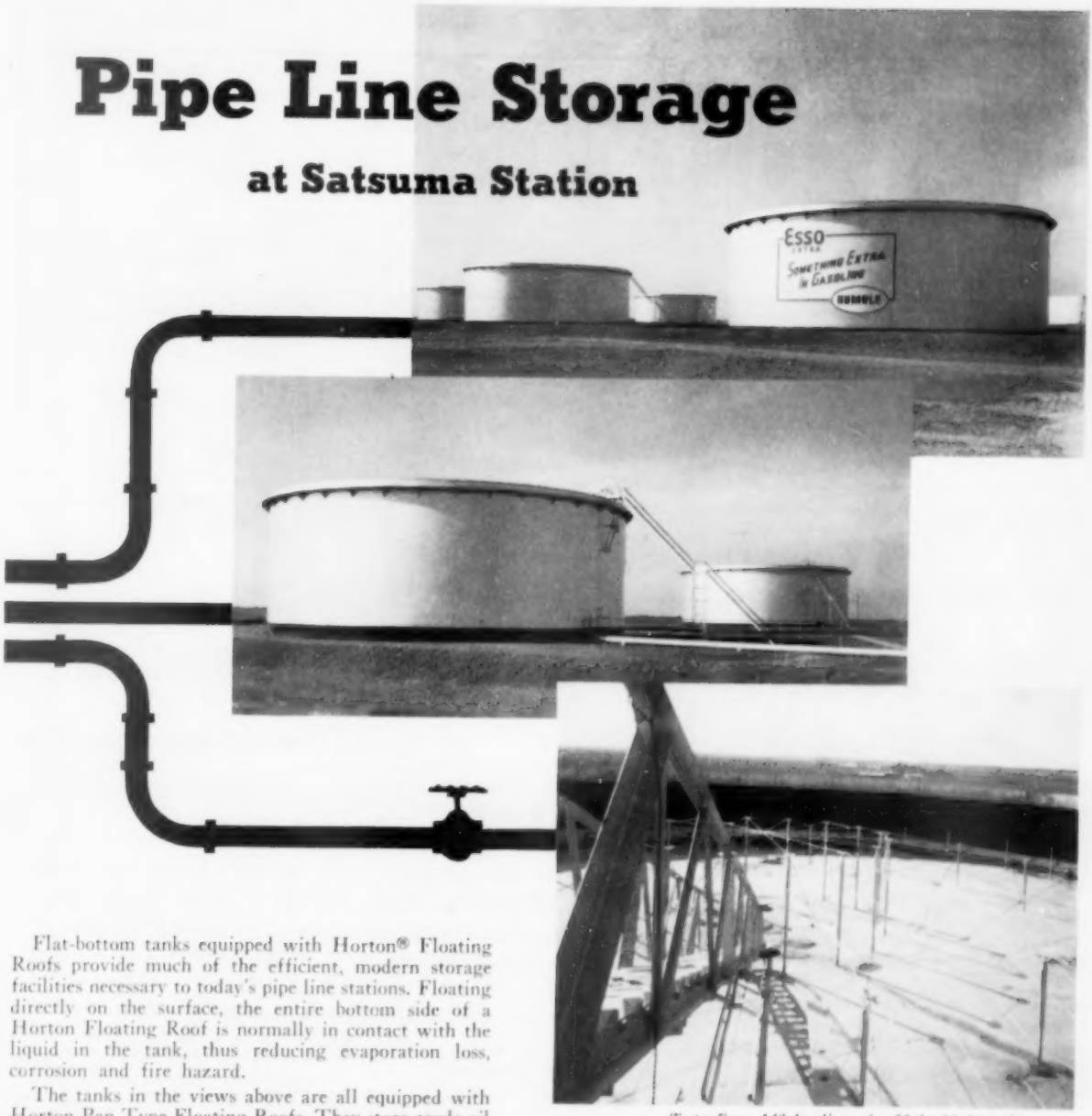
THESE CONTACTORS remove acidic gases (CO_2 and H_2S) from the high-CO_2-content natural gas by means of a 20 per cent MEA solution.



THREE 80,000-lb. per hour water-tube boilers are used at the plant. Two of them furnish steam for driving pumps and the third is a standby.

Pipe Line Storage

at Satsuma Station



Flat-bottom tanks equipped with Horton® Floating Roofs provide much of the efficient, modern storage facilities necessary to today's pipe line stations. Floating directly on the surface, the entire bottom side of a Horton Floating Roof is normally in contact with the liquid in the tank, thus reducing evaporation loss, corrosion and fire hazard.

The tanks in the views above are all equipped with Horton Pan Type Floating Roofs. They store crude oil at the Humble Pipe Line Company's Satsuma Station near Houston, Texas.

Further information, estimates or quotations on Horton Floating Roofs—Double-Deck, Pontoon or Pan—may be obtained by writing our nearest office.

Top: Four 140-ft. diam. by 51-ft. high tanks equipped with Horton Pan Type Floating Roofs at Satsuma Station near Houston, Tex.

Middle: 140-ft. diam. by 51-ft. high tanks with Horton Pan Type Floating Roofs.

Bottom: Looking into a tank equipped with a Horton Pan Type Floating Roof. The space between the edge of the deck and the shell of the tank is closed by a Horton Seal, standard equipment on all Horton Floating Roofs.

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Plants in BIRMINGHAM, CHICAGO, SALT LAKE CITY and GREENVILLE, PENNSYLVANIA

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Birmingham, 1 ..... 1536 North 50th St.
Boston, 10 ..... 1025—201 Devonshire St.
Chicago, 4 ..... 2128 McCormick Bldg.
Cleveland, 15 ..... 2204 Midland Bldg.
Detroit, 26 ..... 1514 Lafayette Bldg.
Houston, 2 ..... 2119 C & I Life Bldg.
Los Angeles, 17 ..... 1523 General Petroleum Bldg.
New York, 6 ..... 3347—165 Broadway Bldg.
Philadelphia, 3 ..... 1615—1700 Walnut Street Bldg.
Pittsburgh, 19 ..... 3228 Alcoa Bldg.
Salt Lake City, 4 ..... 525 West 17th South St.
San Francisco, 4 ..... 1554—200 Bush St.
Seattle, 1 ..... 1325 Henry Bldg.
Tulsa, 3 ..... 1606 Hunt Bldg.

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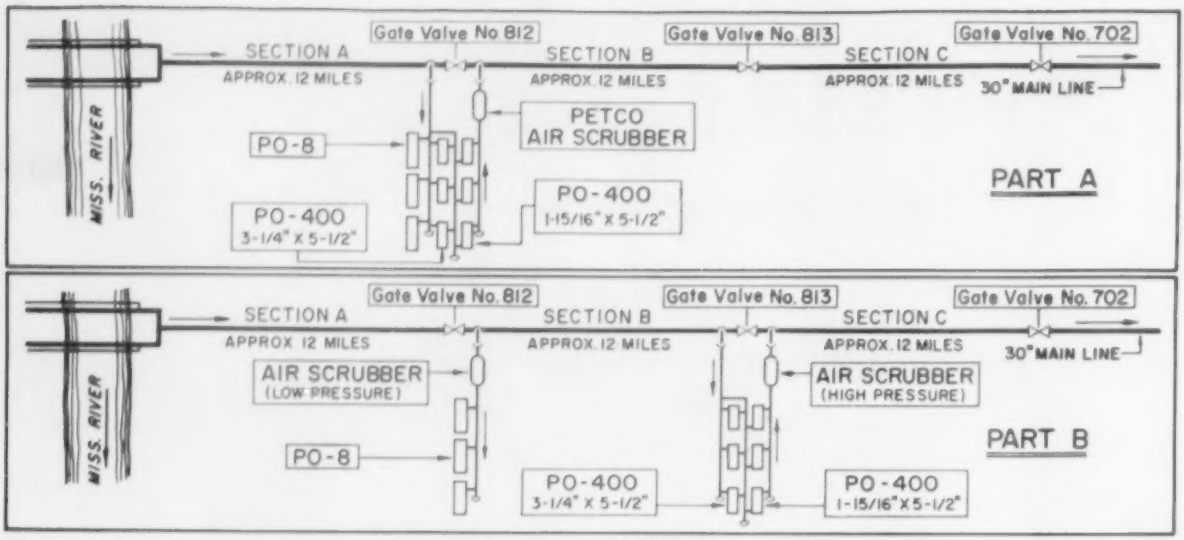


COMPLETE portable compressor installation at a typical base location (Part A). As the air cleaning and testing operation proceeds, three PO-8 compressors are left at base location and six PO-400 units are moved to a second gate-valve setting. Fig. 1.

Gulf Interstate develops an effective technique for

High-Pressure Air Testing and Cleaning

of its 850-mile gas trunkline

by G. E. Foulke

Successful use of high-pressure air for testing and cleaning this 850-mile, 30-in. gas line may pave the way for the rapid adoption of this method of testing by others in the gas pipeline industry.

WHEN Gulf Interstate Gas Co.'s 850-mile, 30-in. main line goes into operation this fall it will represent the first major pipeline system to have been cleaned and tested by high-pressure air.

With construction of the new pipeline nearing completion, Gulf Interstate is able to point to the complete success of this advanced cleaning and testing technique. The main advantages found in the use of air compared to conventional methods of testing with gas or water were:

... **1. Cheaper.** Air is free, compared to the expense of gas or water (removal of the latter is extremely costly).

... **2. Faster.** By using air, the cleaning and testing program could be initiated immediately behind construction crews, thus eliminating the 2 or 3-month delay normally required to place the line in service.

... **3. Safer.** There is no possibility of fire with the use of air, reducing the amount of expensive safety precautions normally required.

... **4. Surer.** Using air permits a "flat" test and a means of greater degree of certainty.

Important Development

While the use of air for cleaning and testing purposes was not original with Gulf Interstate, its adaptation to the main line of this new system marks an important development in pipeline construction. The company has been able to prove that there is no physical limit to the use of high-pressure air for this operation, whereas previously its employment had been restricted to shorter, smaller-diameter pipelines.

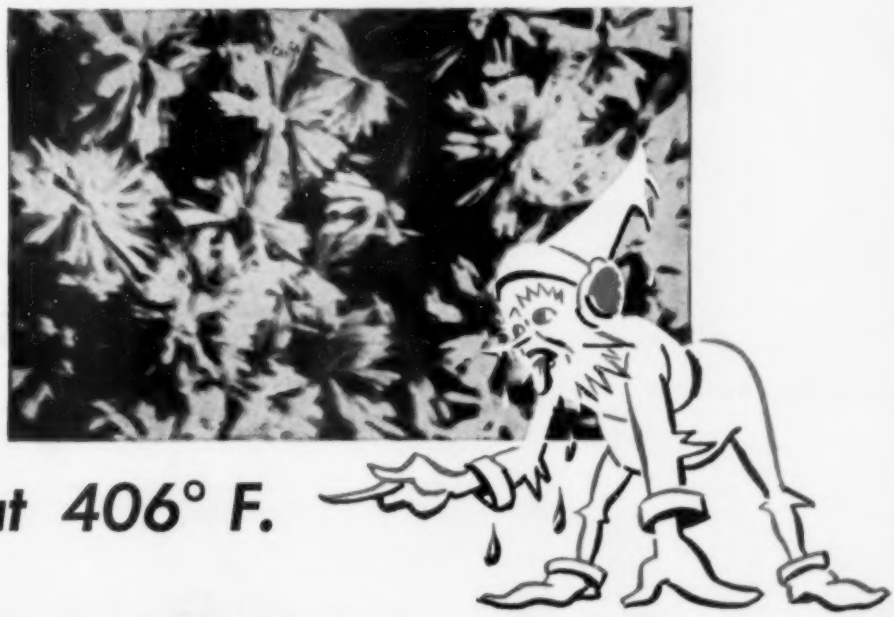
Gulf Interstate's system, which includes 309 miles of gathering lines in addition to the 850-mile main line, has been built for the purpose of transporting natural gas for United Fuel Gas Co., a subsidiary of Columbia Gas System. Columbia supplies nearly 3,000,000 consumers in seven eastern states and the District of Columbia. Gulf Interstate's initial delivery capacity will be 375 M.M.c.f. of natural gas daily, using 40,000 hp. at five compressor stations. The two main branches of Gulf Interstate's gathering system spread out over southern Louisiana, intersecting with the main line at Rayne, La. From there the pipeline stretches in a northeastward direction across Louisiana, Mississippi, Tennessee, and Kentucky, connecting with United Fuel at the Kentucky-West Virginia border.

It is estimated that approximately 450 M.M.c.f. of air at atmospheric pressure was used for cleaning and testing the 850 miles of 30-in. pipe.

Choice of Equipment

Several factors were of prime consideration in the original selection of compressor equipment necessary for the air test operation. First it was decided to equip two cleaning and testing crews—one on the north half and a

JACK FROST



at 406° F.

MAGNIFIED fifty times, the calcium carbonate scale in the photo above might easily be mistaken for a frosted window pane. It was formed at 250 p.s.i. in one of the Nalco Laboratories' test boilers as a part of the continuing Nalco research program, aimed at keeping such scales *out* of your power plant equipment.

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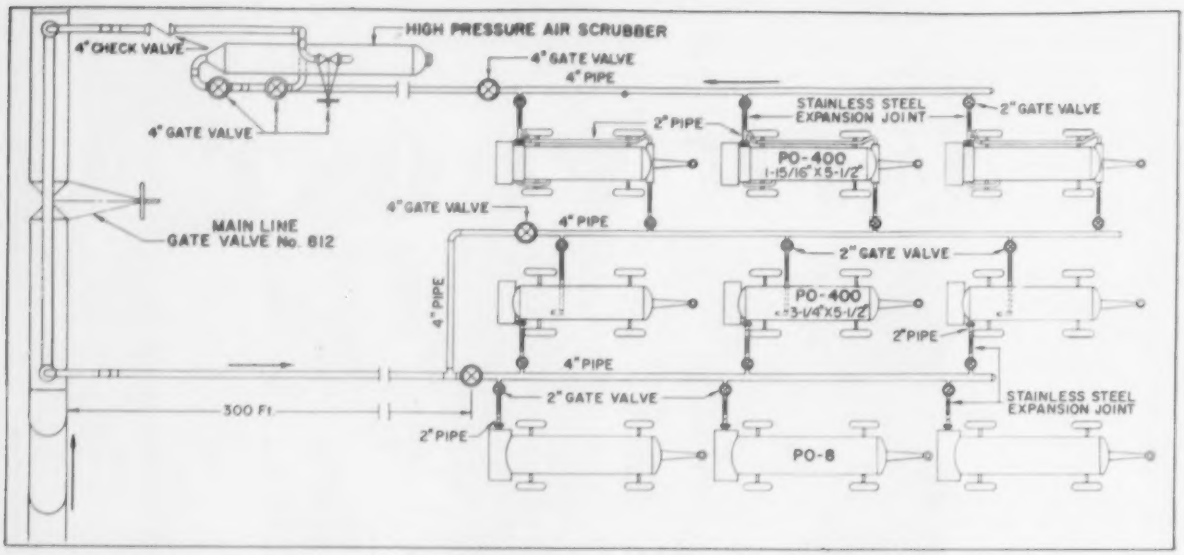


ARRANGEMENT of compressor units and manifold piping at one of the portable cleaning and testing stations. **Fig. 2.**

Construction Section

second on the south half of the system—in order to complete the operation on schedule. Secondly it was calculated that each crew would require equipment producing 800 hp. to compress the amount of air required to clean and test approximately 425 miles of main line. Thirdly it was necessary that the compressor units be highly portable, flexible, and require minimum care and maintenance. Lastly, the units had to be ready for immediate delivery as construction crews were already moving onto the right-of-way and time was of the essence.

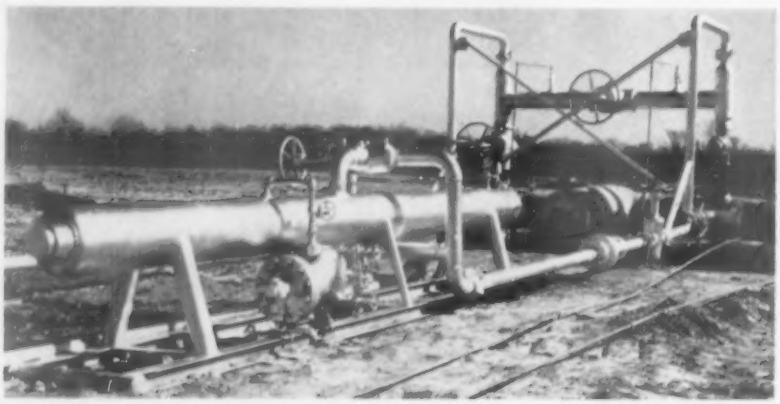
With these factors in mind, Gulf Interstate selected Chicago - Pneumatic, diesel-driven PO-8's and PO-400's to handle the air cleaning and testing job. These units provided the additional feature of four-stage air compression with inter and aftercoolers, thus eliminating excessive temperatures and permitting more economical operation of the available horsepower.

For each of its two testing crews, Gulf Interstate purchased three PO-8 and six PO-400 compressors. Of the latter, three were 3¼ by 5½-in. units and three were 1⅞ by 5½-in. units. It should be pointed out that the choice of equipment, as well as development of the cleaning and testing procedure, originated with the engineering department of Gulf Interstate. (A list of equipment and manpower for the entime operation is shown in Table 1.)

Typical Test Installation

After the selection of starting points—determined by the state of construction—the first step in the cleaning and testing operation was to install a base station. Typical of these sites was gatevalve setting No. 812 approximately 12 miles east of the Mississippi River crossing. The latter is located just south of Hollandale, Miss., as shown in Fig. 1.

At this base station, the nine portable compressors were manifolded together in such a manner to permit each



AIR SCRUBBER installed between compressors and main line to remove water and compressor lubricating oil from the compressed air. **Fig. 3.**

AIR IS COMPRESSED into Gulf Interstate's main line by these six PO-400's which had been moved from the base station where three PO-8's were left pumping. **Fig. 4.**

Dowell offers a wide variety of acid addition agents designed to solve individual well problems. Trained engineers apply these chemicals according to the latest techniques, using modern treating tools and high-pressure, high-volume pumping equipment.

HIGH TEMPERATURE WELL ACIDIZED WITHOUT CORROSION

DOWELL inhibited acid also helped increase production from 0 to 972 bbls. on 7-hour test

Acidizing without properly inhibited acids has resulted in corrosion damage to well equipment in too many cases. Not only is this a costly and inefficient way to operate, it is also unnecessary!

Dowell was the pioneer service company using inhibited acidizing to increase oil well production and, at the same time, leave the metal well equipment undamaged. Today, the inhibitors developed and used by Dowell are the most effective known. For example, a well had a bottom hole temperature of 210°F. A previous acid treatment had resulted in corrosion damage and had failed to increase production appreciably. Then Dowell was called to treat the well with "high-temperature inhibited" acid. Production went from almost 0 to 972 bbls. on a 7-hour test. Inspection showed no acid-corrosion damage.

Laboratory tests show that the Dowell high-temperature inhibitor reduces the corrosion rate of hydrochloric acid upon steel, expressed in terms of metal loss, to approximately .05 lbs. per sq. ft. per day at temperatures as high as 300°F. This inhibitor is effective even up to 400°F.

For service or information about acidizing, fracturing, Electric Pilot and jet perforating, call your nearest Dowell representative, or write directly to Dept. I-11, DOWELL INCORPORATED, Tulsa 1, Oklahoma.

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SPECIALLY DESIGNED pig launcher used in air cleaning operations was designed to launch several cleaners and squeegees in succession at predetermined time intervals without shutting down air pressure. Fig. 5.

THE AUTHOR, G. E. Foulke, chief dispatcher for Gulf Interstate, observes the pressure on a deadweight operation. Foulke, a graduate of Iowa University, supervised the air-cleaning and testing operation. Fig. 6.

Construction Section

unit to operate either in parallel or in series. In other words, all nine units could operate simultaneously while the air pressure was being pumped up from atmospheric level to 150 psi., and as the pressure was increased above 150 psi. the units could be placed in series, see Fig. 2.

A common 4-in. header was installed to give maximum flexibility for the entire setup and at the same time to minimize pulsation of the air flow. A 4-in. line around the three larger PO-400 units was installed to allow bypassing of these compressors once pressure was equalized in the two adjoining sections of the pipeline. This permitted utilizing only the smaller units when pumping with small pressure differentials at high pressures.

As will be noted in Fig. 2, the 2-in. lines connecting the compressor discharge with the 4-in. header included a 3-ft. joint of expansible stainless-steel hose. This hose has a working pressure of 1,200 psi. and a working temperature of 400° F. It contained sufficient flexibility to ease the alignment problem in setting up the station and also served as an expansion joint during operation. All sections of the

(Continued on page 242)

TABLE 1

Air Cleaning and Testing Operation Equipment and Manpower Requirements

Equipment—
3 PO-8 compressors (basic)
3 PO-400 compressors (3¼ by 5½-in.)
3 PO-400 compressors (1⅛ by 5½-in.)
2 Air scrubbers
1 Shelter house (work room and parts)
Required manifold piping
Pig launcher and catch joint
1 D7 boom tractor
1 Lowboy truck
1 Float truck
2 Winch trucks
2 Power wagons with welding machine and beveling machine
3 Radio vehicles
1 Pickup truck

Manpower—
1 Foreman
1 Mechanic
1 Compressor operator per shift
1 Welder foreman
2 Welders
2 Welder's helpers
1 D7 tractor operator
1 D7 tractor swamper
4 Truck drivers
8 Utility men

The above list represents the total required equipment and manpower for all phases of the cleaning and testing operation, as well as the equipment and manpower required for setting the main line gate valve and drips.

TABLE 2

Typical Data for Air Scrubber Gate Valve 813 to Gate Valve 702 (Near Belzoni, Miss., October 26, 1953)

Time—	Temp. at scrubber (°F.)	Fluid removed by scrubber (gal.)	Dead-weight line pressure (psi.)
12:01 a.m.	84	12	936
3:00	86	13	945
6:00	88	15	957
9:00	88	15	967
12:00 noon	88	15	977
3:00 p.m.	90	15	987
6:00	91	15	998
9:00	88	15	1,008
12:01 a.m.	82	15	1,018
3:00	80	15	1,029
6:00	76	16	1,040
9:00	74	18	1,050

179 gal. of fluid removed by air scrubber during this 33-hour period.

TABLE 3—CLEANING AND TESTING CREW

Date: November 19, 1953. Starting time: 12:48 p.m. Finishing time: 1.25 p.m. Starting pressure 959 psi. Finishing pressure 850 psi.

Launching Barrel to Blow Joint
(Gate Valve No. 711 to No. 712)

Pig cleaner No.	Initial time	Final time	Minutes elapsed	Initial pressure	Final pressure	Pressure drop
1	12:48 p.m.	1:04 p.m.	16	959	931	28
2	1:00 p.m.	1:16 p.m.	16	939	912	27
Purge No.	**Initial time**	**Final time**	**Minutes elapsed**	**Initial pressure**	**Final pressure**	**Pressure drop**
1	1:18 p.m.	1:23 p.m.	5	905	850	55

Remarks: Obtained excellent cleaning job.

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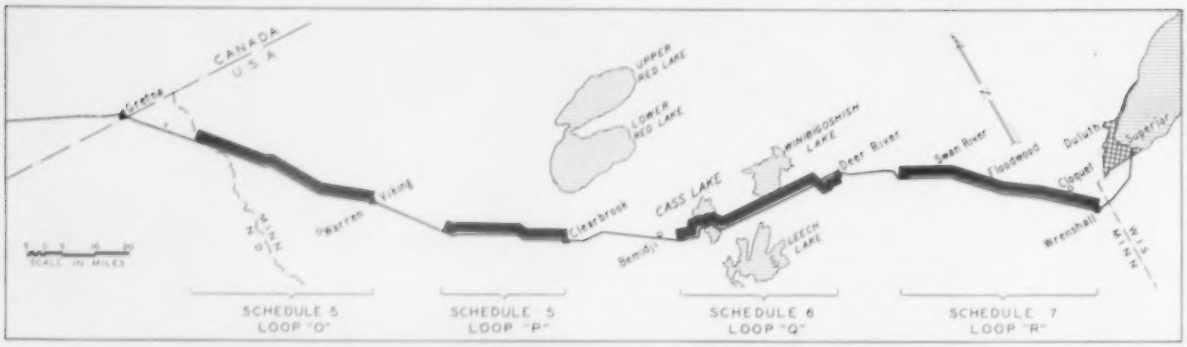
Dependable, Low-Cost Electric Service to Help Build Oklahoma



MAP SHOWING LOCATION of loops constructed this year on Lakehead Pipe Line's system.

Pipe being wrapped with rock shield before making a swamp crossing.

Lakehead Pipe Line Looping Program

Welding and Coating for Swift Progress

by Paul Reed
Pipeline Editor

THE Lakehead Pipe Line Co., Inc., (affiliate of Interprovincial Pipe Line Co.) is engaged in a looping program this year in northern Minnesota where construction is carried on under conditions where both fast overland pipe laying and slower swamp operations may be observed. The project is conducted under the direction of T. S. Johnston, president, and R. E. Trammell, general manager.

The author was assisted by W. E. Emmons, district superintendent, and Robert Hewley, district engineer, during a visit to the project in August.

This article describes the welding and coating practices adopted for effective progress in traversing the different types of terrain encountered.

The 1954 Lakehead pipe laying project consists of 195.8 miles of 26-in. pipe in four loops, all in Minnesota. These are part of the combined 600-mile Interprovincial looping and pump station program for raising capacity, from the present one of 123,000 bbl. to 160,000 bbl. per day for the entire line from Edmonton, Alta., to Sarnia, Ont. In connection with this undertaking, Lakehead is installing 15,520 hp. in diesel centrifugal pump units. At three stations—Viking, Clearbrook, and Deer River—two 2,000-hp. units are being installed to double the capacity at each of these stations. A new station is being built at Saxon, Wis., with two 1,760-hp. diesel centrifugal units to duplicate the Superior, Wis., station, 86 miles westward from Saxon.

The 1954 looping of the Interpro-

Another new development using

B. F. Goodrich Chemical *raw materials*

B. F. Goodrich Chemical Company does not make this rigid vinyl pipe. We supply the Geon resin only.

Right in the groove - rigid vinyl pipe

THIS is a part of a 3-mile installation of rigid vinyl plastic pipe in the oil fields of Ellis County, Kansas. It carries hot salt water—a corrosive by-product of crude oil—from a separating tank to a deep disposal well.

Oil company engineers chose *high-impact* rigid vinyl pipe made from Geon resin because it won't corrode, can stand roughest handling and has better chemical resistance. Another advantage: Money is saved in ditching operations for other pipe made of brittle materials must be cradled in a more costly graded ditch to avoid damage.

This high-impact rigid vinyl pipe has so many advantages that it may suggest a use to you or may give you an idea for an equally successful product. There are scores of other uses for Geon materials—from rigid sheets and panels to flexible colorful upholstery, wire insulation, durable flooring, sponge and many more. For information on Geon materials, please write Dept. HJ-10, B. F. Goodrich Chemical Company, Rose Building, Cleveland 15, Ohio. Cable address: Goodchemco. In Canada: Kitchener, Ontario.

GEON RESINS • GOOD-RITE PLASTICIZERS . . . the ideal team to make products easier, better and more saleable
GEON polyvinyl materials • HYCAR American rubber • GOOD-RITE chemicals and plasticizers • HARMON colors

Coating and wrapping machine on R. H. Fulton & Co. spread near Warren, Minn.

Coating yard operating near Cloquet, Minn., to prepare pipe for laying swamp areas.

vincial system in Canada is done with 24-in.-diameter pipe.

The Lakehead looping program is divided as follows:

Schedule 5, contracted by R. H. Fulton & Co., includes Loop O, 49.7 miles from the North Dakota-Minnesota boundary to Viking station, and Loop P, 35.5 miles from a point near Plummer to Clearbrook station. Loop P has been completed and the spread is now laying Loop O.

Schedule 6, contracted by Anderson Brothers Corp. consisting of Loop Q, 52.3 miles, is entirely completed from a point halfway between Bemidji and Cass Lake to the Deer River station.

Cass Lake water crossing of 1.2 miles contracted by Mahoney Contracting Co. has been completed. The Cass Lake crossing is within the limits of the area covered by Schedule 6.

Schedule 7, contracted by R. H. Fulton & Co. consisting of Loop R, 58.3 miles from a point near Warba to Wrenshall, is now under construction.

The terrain is glacial drift containing many rocks about as big as a man's head. But practically no ledge rock was encountered.

The pipe is X-52 pipe with 9/32-in. wall except at river crossings where ½-in.-wall pipe is used.

Pipe is protected by coal-tar enamel, glass mat, and felt.

Work began June 1 and it will be completed September 30.

Construction Practices

Since the 26-in. loops laid in 1954 are located only 10 ft. from the 18-in. line built in 1950, the position of the 18-in. had to be carefully determined by pipeline-locator instruments and by spotting bars.

The ditch is 36 in. wide and 5 ft. deep for approximately 3 ft. of cover.

There has been no cradling into the ditch except during one week when the Fulton spread on Schedule 5 gave this practice a thorough test but discontinued it as too much ditch was lost because of the soft ground.

Lowering in is done with slings. Skids supporting the slack loops are protected by rubber tires at the Fulton spreads, but pads at the skids were not used in the section laid by Anderson Brothers.

For patching at the skid marks 12 by 16-in. patch pads are used which are more effective than ragging on a flood coat in the usual way. And they cost about a third as much.

R. H. Fulton & Co. Progress

In building loops for Schedule 5, R. H. Fulton & Co. spread progressed at the rate of a mile a day per working day in laying the 35.5 miles for Loop P.

The rate of progress was doubled to 2 miles per day later when this Fulton spread became engaged in laying the 49.7 miles over the favorable plains terrain for Loop O.

Welding

The fast pace hit by the Fulton spread of 2 miles a day on Loop O of Schedule 5, is facilitated by a pipe gang with three stringer-bead welders and five hot-pass welders.

The three stringer-bead welders work simultaneously—one on the top and two on the sides.

Four of the hot-pass welders work in pairs. The fifth hot-pass welder works by himself at a skip location.

The pipe gang for the Schedule 7 spread has a total of 20 men including 12 men in addition to the 8 welders.

For this entire spread, there is a total of 27 welders. In addition to the 8 welders in the pipe gang, there are 15 bell-hole welders on the firing line, 2 utility welders, and 2 tie welders.

This pipe gang of the Fulton spread was progressing at the rate of 250 to 270 welds per 10-hour day when the author contacted it early in August near Warren, Minn.

The 16 welders in the Fulton spread for Schedule 7 included the following early in August when it was working near Floodwood: two for stringer beads, four for hot pass, seven for finish, one utility welder, and two tie-in welders.

Welders Own Rigs

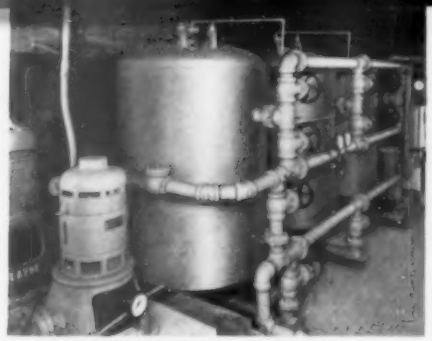
All of the welding rigs behind the pipe gang in the Fulton spread working on Schedule 5 are owned by the welders in accordance with a practice that the Fulton organization has been favoring in recent years.

The 300-amp. welding units for the stringer-bead and hot-pass welders in the pipe gang are owned by the contractor. But the mobile welding rigs with 200-amp. machines for finish, tie-in, and utility welding are owned by the individual welders operating them. The contractor furnishes gasoline, oil, and welding rods and pays each welder $5 per hour for his services and the hiring of his rig. The welder is responsible for maintenance of the rig used by this arrangement.

Welders who own their own mobile rigs are men of long experience with good records of reliability.

The rigs are mounted on a variety of pickup trucks, some of which have special transmissions. Cost of these mobile rigs runs from $4,000 to $5,000.

A different policy is followed for the Fulton spread for Schedule 7 where the large amount of swampy ground is unfavorable for the pickup-truck type of mobile rig. There the contractor fur-



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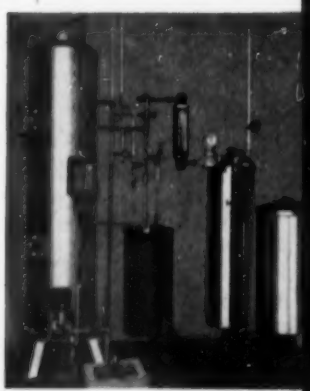

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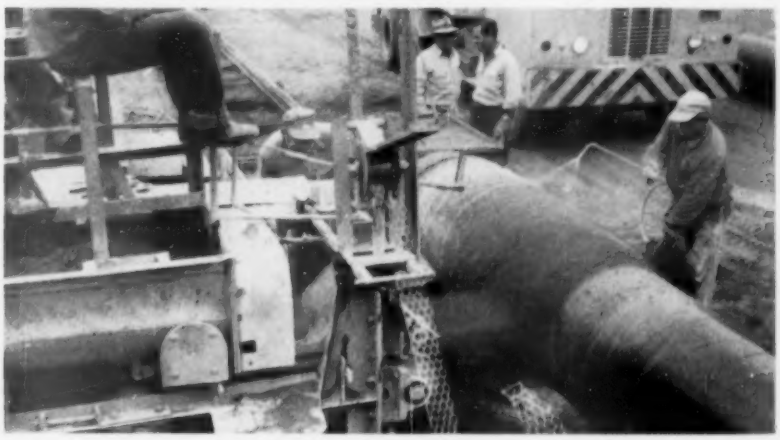
"Standard of the Highway"

Hot-pass welders working immediately behind stringer-bead welders on right-of-way where yard coated pipe is welded preparatory to making a swamp crossing near Floodwood, Minn.



Concrete jacketing being applied to pipe by the Wate-Kote method for the Cass Lake crossing.

nishes all welding rigs. Sled-mounted welding units are used for operations behind the pipe gang. Track-mounted units serve the pipe gang.

Aid to Welding Inspection

The welding inspector on Schedule 5 has adopted a policy of getting welders to indicate by a chalk mark any of their welds they consider doubtful in order that they may be X-rayed. In doing this, a welder is protected against being penalized if his output on the whole is consistently good. Experience with X-raying these doubtful welds shows that most of them are found to be satisfactorily sound when the radiograph negatives of them are examined by the welding inspector. The company benefits from this practice by additional safeguard that welding be of a consistently high standard. This practice is regarded as a distinctive feature of construction for Schedule 5.

At this spread an average of three welds per day are cut out after radiographic inspection.

Anderson Brothers Operations

In its swamp construction, Anderson Brothers Corp. coated and wrapped the pipe on firm ground with on-the-line traveling-type equipment. Pipe was protected by rock shield. Sections of six to eight joints were added to the long section pushed and pulled through the swamp. After pulling, the bull plug at the front end of the line was removed, the line filled with water, sank in the ditch, and was backfilled.

In the 51.1 miles laid by Anderson Brothers for Schedule 6, there was a total of 17 miles of swamp. Sections pulled were sometimes 2 and 3 miles long.

In spite of the delays in swamp construction, the whole of Schedule 6 was constructed at the average rate of a mile a day. Operations were favored by the fact that a large part of the route was within 100 yards of a hard-surfaced highway and followed a fire lane for a considerable distance. Work of the Anderson Brothers spread had been completed before the author visited the project.

Swamps

A stretch of 23 miles of swamp land in Schedule 7 between Floodwood and Swan River is the worst terrain for construction in the whole Interprovincial-Lakehead system from Edmonton to Sarnia. Not only is this area difficult because of the peculiar swamp conditions, but it is inaccessible. There are 12-mile sections which can be reached by only one road. Corduroy roads had to be built extensively to facilitate construction.

The Minnesota swamps frequently consist of floating crusts of peat, 8 to 10 ft. thick, that are strong enough to hold a pipeline. However, the heaviest construction equipment would break through and sink into the water below on which the peak crusts float. In much of this kind of swamp country, the movement of such equipment as backhoes must be carried on by the use of wood mats. These swamps have been compared with those of Louisiana. But in Louisiana swamps there is a bottom. In Minnesota, the bottoms are often pools of water.

Swamp conditions are so widespread in the area traversed in Schedule 7 it was decided from the start to use yard-coated pipe there in order to avoid moving heavy coating and wrapping equipment into swampy ground. In Schedule 7, swamps totaled 23 miles out of a total of 58.3 miles. For normal construction over consistently long stretches of dry land, preference is given to traveling-type coating operations.

The treacherous nature of the bottomless Minnesota swamps was demonstrated during the 1950 construction of the original 18-in. line when a swamp buggy dropped clear out of sight in the water below the floating boggy peat crust.

As a result of its experience in laying the 18-in. line through this area in 1950, Lakehead specified coating of pipe by yard application with the pipe pushed through the machine without rotation. By this procedure, the yard coating and wrapping machine rotates around the pipe in the same way that it does for a machine traveling on the pipe in usual "over the ditch" operations. It has been observed that by the nonrotation method, defects are avoided that are due to loose paper and sags in the coating. Lakehead now has a basis for comparing results by the rotation method for 18-in. pipe in 1950 with those of the nonrotation method

ETHYL RESEARCH BUILDS A "WHIRLING PIN CUSHION"

to probe the secrets of combustion deposits

A special whirling disk developed by Ethyl research people may help technologists come up with the answer to one of the "hottest" problems facing the petroleum and automotive industries.

The problem: Exactly what can be done about the deposits that build up in the combustion chamber of a modern gasoline engine?

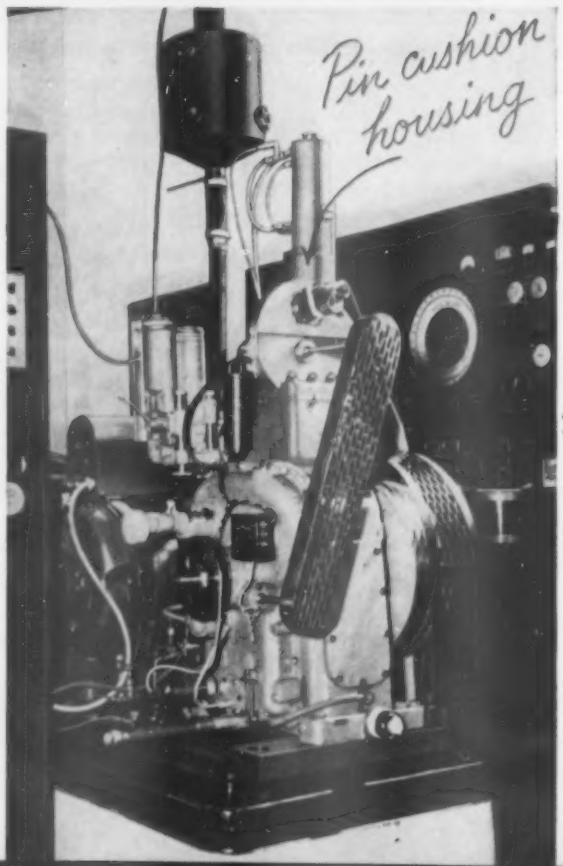
Only when researchers can understand what they are and how they form through the interaction of fuels, oils, additives and the metals of the engine, will it be possible to render these deposits harmless.

Ethyl research people have been at work on the problem for years and in many different ways. Recently, they made another step forward when they developed an amazingly simple test instrument they affectionately call the "whirling pin cushion."

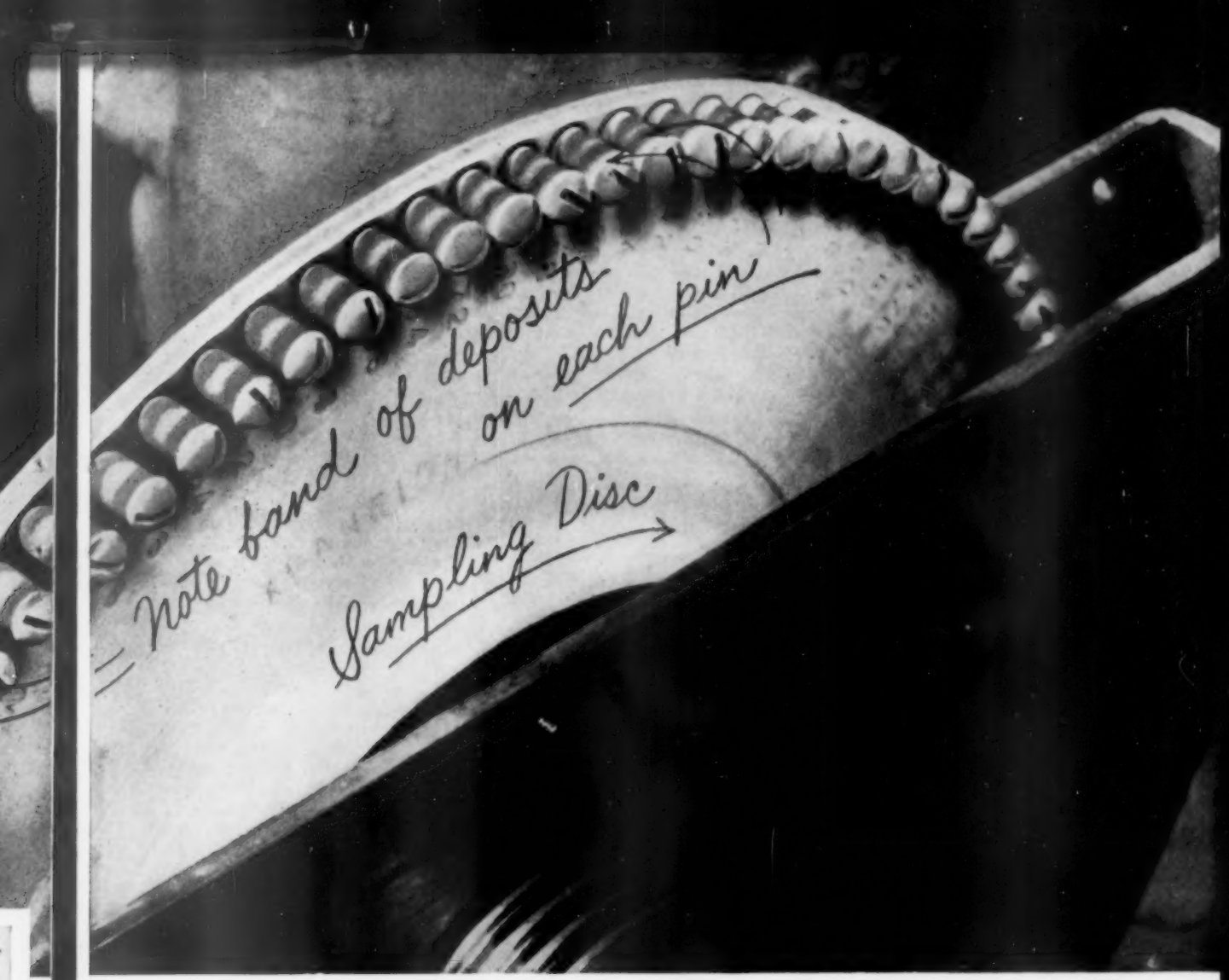
By spinning the pin cushion in a special test rig, researchers are now able, for the first time, to trace the step-by-step formation of combustion products—at all phases of the cycle.

This is another milestone in basic research on combustion-chamber deposits.

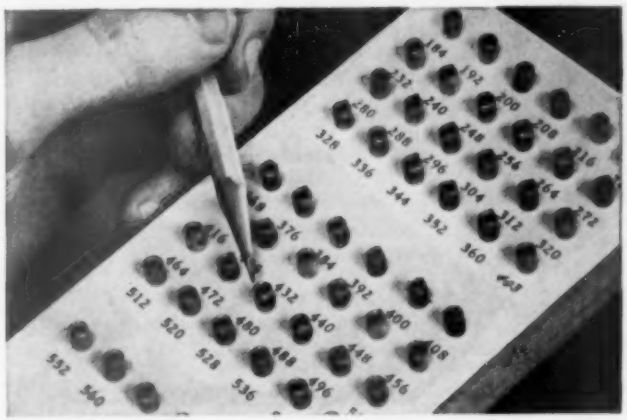
New test instruments at Ethyl Laboratories like the "whirling pin cushion" are helping us piece together the fundamental knowledge which will eventually open the door to engines and fuels of far greater efficiency than are possible today.



Special test engine synchronizes the "whirling pin cushion" with the engine cycle so that each pin picks up deposits from exactly the same portion of the cycle each time.



Sampling "pins" on Ethyl's "whirling pin cushion" move past a specially constructed opening in the cylinder head of a test engine and pick up combustion deposits—as they are being formed.



Each pin on the disk accumulates deposits formed.

Ethyl laboratories "fingerprint" the deposit on each sampling "pin" by X-ray diffraction.

ETHYL CORPORATION
Research Laboratories
1600 West Eight Mile Road, Ferndale 20, Michigan
2600 Cajon Road, San Bernardino, California

for 26-in. pipe laid in the same area in 1954.

Mats

In traversing swamps, backhoes move on 4 by 12-ft. mats made of 3 by 12-in. timbers, which cost about $220 each. A backhoe manipulates four mats of this kind, shifting them ahead as it progresses through the swamp.

At one 11-mile swamp section, the original 18-in. line was laid in 1950 on top of and along the edge of a corduroy road. In this same section, the 26-in. loop is being buried in the swamp.

Yard coating for Loop R in Schedule 7 was subcontracted by Fulton to Tulsa Pipe Coating, Inc. The yard, operated by 33 men, was first established at Cloquet and later moved to Swan River, Minn. Basic equipment for the yard process was furnished by M. J. Crose Manufacturing Co., which supplied equipment for the Fulton spreads laying the 1954 Lakehead loops.

Cleaning-and-priming and coating-and-wrapping machines rotate around the pipe since the pipe is pushed through without rotation of the pipe itself.

While specifications call for 3/32-in. coating, the usual practice is to apply 4/32-in. In yard operations it has been found that there is less waste of material.

Coal tar is 490° F. at the kettle and 450° F. when it reaches the dope machine. Spray shoe working temperature is 350° F. Immediately after leaving the dope machine the pipe passes through a 27-ft. circulating water spray striking the pipe at the top and bottom. This spray reduces the temperature to 100° F. Within 10 minutes after leaving the bath, the coating is hard.

In going from the cleaning-and-priming and dope machines, the pipe is supported on low-inflation auto tires serving as rollers. From the tires the pipe is pushed to padded racks by hydraulic kickoff devices.

Normal capacity of this yard is 8,000 ft. per day. When required, it has produced as much as 10,000 ft. per day.

On stringing trucks transporting the yard-coated pipe to the right-of-way, the lower tiers of joints are supported on bolsters cushioned by thick rubber padding. There are five joints in each load. Pipe is unloaded at the job in the usual way. The Fulton organization does its own stringing on this project.

Necessarily there must be much patching of yard-coated pipe on the right-of-way to correct defects which occur inevitably in bending and handling.

Cass Lake Crossing

The entire crossing of Cass Lake involved laying 5,400 ft. of which 4,100 ft. is submerged. Laying was contracted by Mahoney Contracting Co. Concrete jacketing was done by Rosson-Richards Co.'s Wate-Kote method at a yard set up near the lake. The 2½-in. jacket of concrete was reinforced by 5-in.-wide band of wire mesh.

The weight of the reinforced concrete was 250 lb. per ft.; when added to the weight of the pipe the total weight was 390 lb. per ft. out of water. In 72-lb. fluid backfill, the concreted pipe has a negative buoyancy of 10 lb.

The entire line was pushed and pulled across the lake. Pipe was added in 700-ft. sections from a site on the shore where it was launched on rubber-tired dollies.

To meet requirements of state conservation authorities, the line was laid in an 8-ft. deep trench which was dug across the lake by a ladder-type suction dredge. Maximum depth of the lake at the crossing is 23 ft. The crossing was laid in 6 weeks.

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Tube-Kote gives you the extra quality of product that makes this company the leader in the industry.

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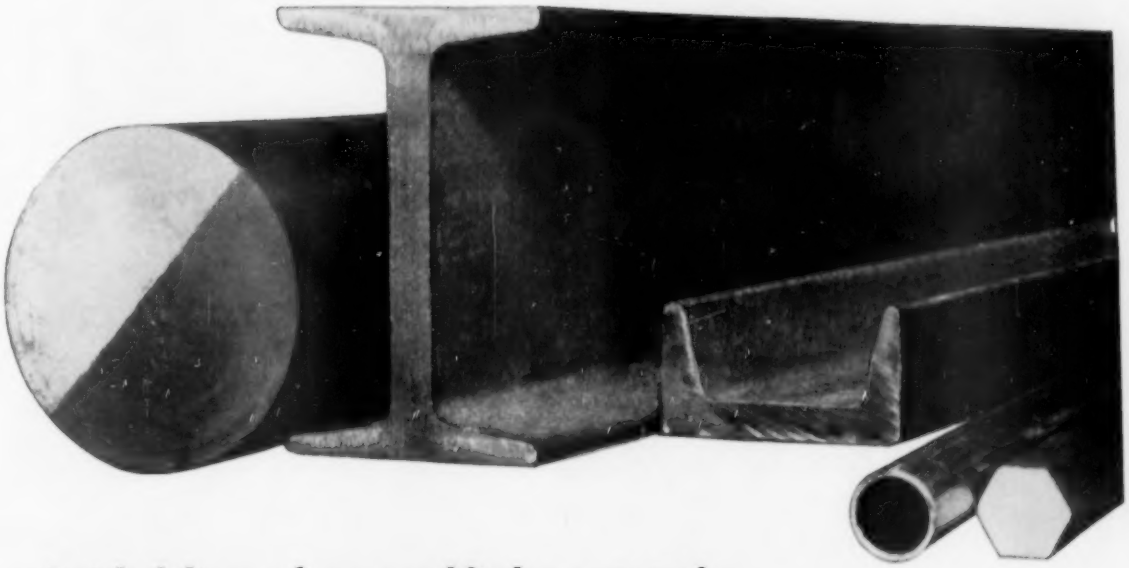

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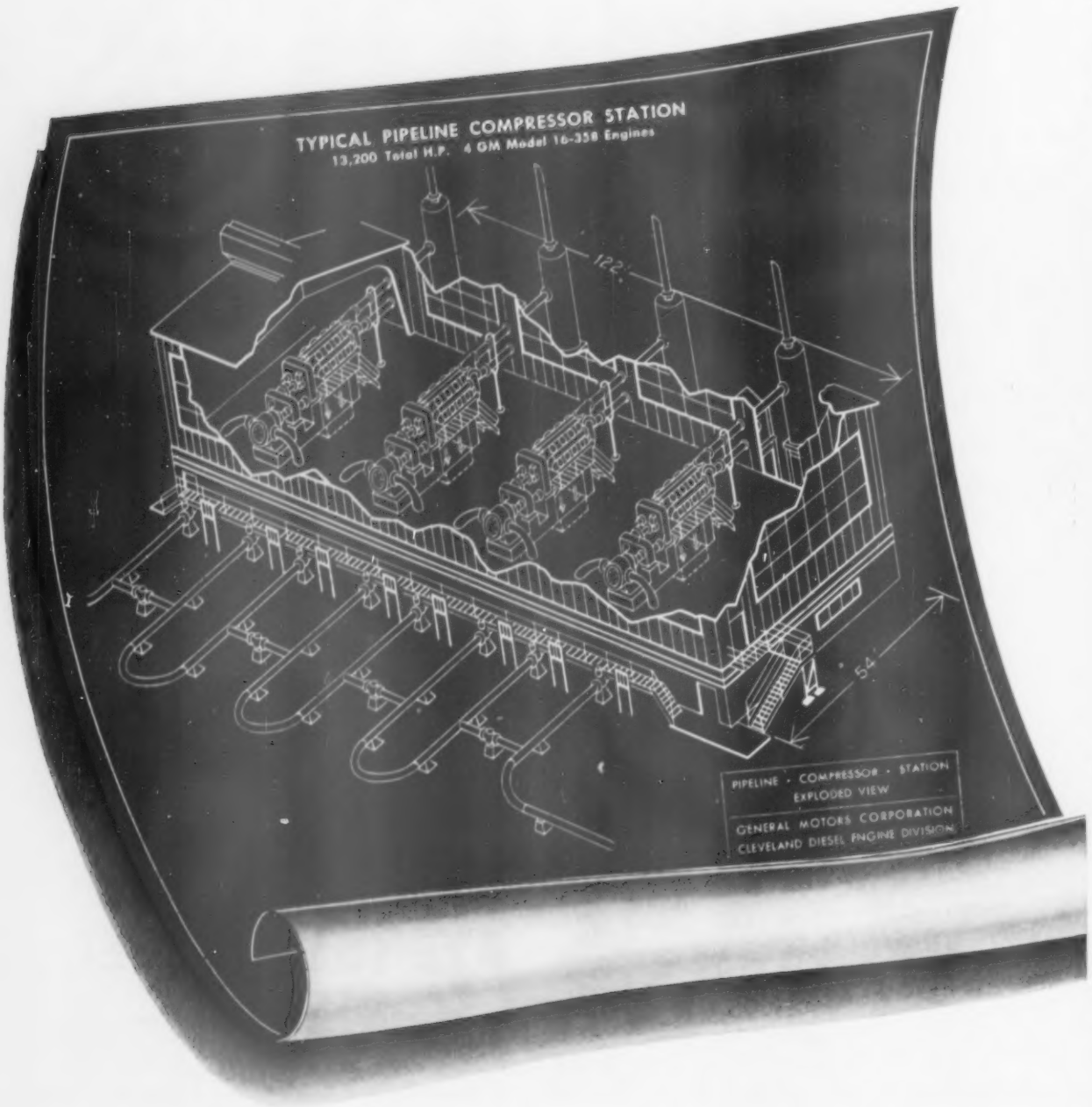
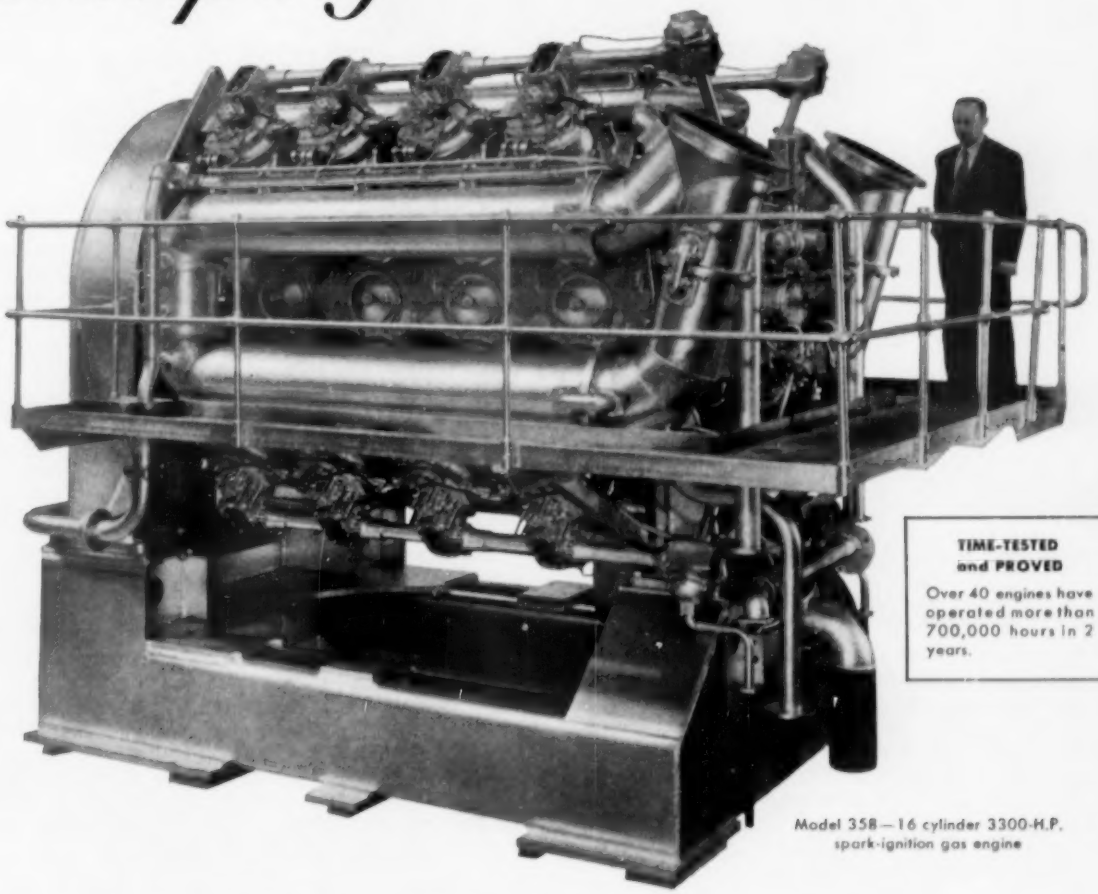
Here's General Motors' *for pipeline*



New Gas Engine *pumping*



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GENERAL MOTORS, world's leading designer and builder of internal-combustion engines, presents the new Model 358 spark-ignition gas engine.

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PIPE GANG of Hallmac Construction Co. near Eldora, Iowa, welding 20-in. pipe with three stringer-bead welders and four hot-pass welders.

In constructing 960 miles of line this year,

Northern Natural Applies Advanced Pipe-Laying Methods

by Paul Reed
Pipeline Editor

IN the laying of more than 960 miles of pipe this year for Northern Natural Gas Co.'s expansion program, the company is applying certain practices it has developed which have been tested in operations during the past 10 years. One of these is the use of extra-heavy pipe for river crossings. Another is the extensive utilization of mill and yard-coated pipe for diameters of 12 in. and smaller.

A notable current feature of Northern Natural's planning is provision for the first underground storage.

Greater flexibility will be given the system if the Redfield storage field near Adele, Iowa, west of Des Moines, proves successful. Here geologists have identified an isolated dome covering 8,000 to 9,000 acres with a water-bearing sand at a depth of 2,700 ft. It appears the field will have a holding capacity of 50 billion cubic feet; an approximate usable capacity of 25 billion cubic feet, and delivery capacity of 200 million cubic feet per day.

Gas-injection testing of the field will be done some time this fall.

The construction program for Northern Natural is directed by J. T. Innis, vice president in charge of operations. The author was assisted in the preparation of this article by M. C. Madsen, chief engineer; A. L. Vaughan, superintendent of compressor stations; W. B. Haas, superintendent of pipelines, and L. J. Cunningham and P. T. McDonough, assistant superintendents of pipelines.

Heavy River Pipe

Extra heavy pipe at river crossings has given such satisfactory performance that the company has adopted the utilization of unusually thick-wall pipe as standard practice for all lines laid in river bottoms.

Dimensions and weights of Northern Natural river pipe are shown as follows:

Diameter (in.)	Wall Thickness (in.)	Weight lb./ft.
16	.843	137
18	.718	132½
20	.812	167
24	.937	231
26	1⅛	299
30	1¼	384

All of this pipe is made of solid wall without laminated fabrication.

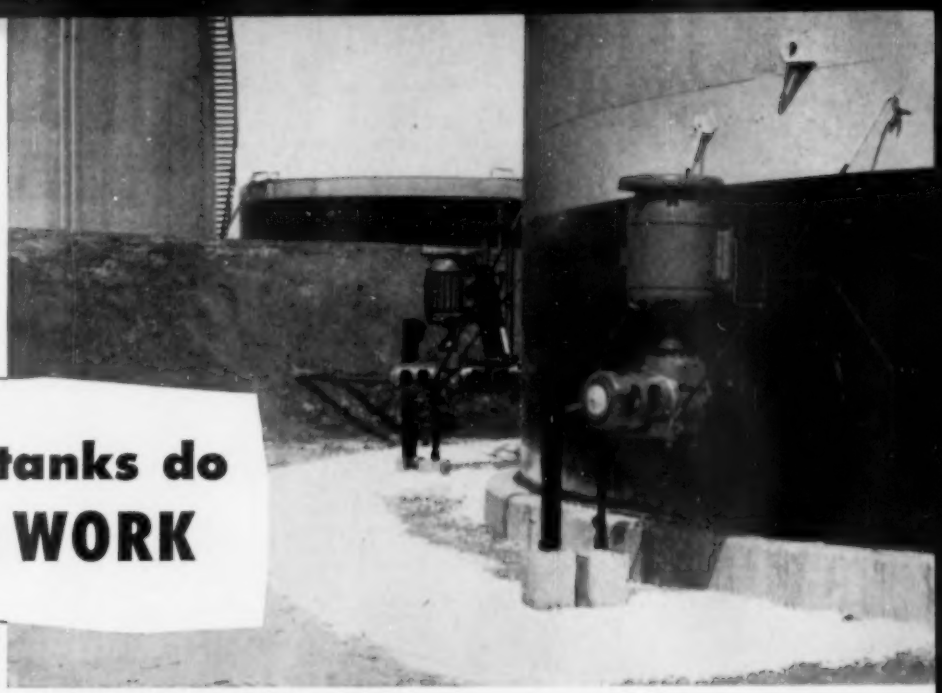
Such river-crossing pipe is made for the company by Taylor Forge Co. It is stress relieved and fully normalized. The welding of the 1¼-in. wall for this pipe requires 29 beads which are applied by two welders in an 8-hour day.

The first extra-heavy wall pipe was 18-in. with .718-in. wall in 1945 at Elkhorn, Neb. Since that time there has been no failure at river crossings where this extra-heavy pipe has been used in the general policy which has now been in effect for nearly 10 years.

In swamps and low ground near rivers where inundation may occur, the company began 2 or 3 years ago to use swamp anchors having a holding strength of 6 to 7 tons apiece for retaining the pipe in place.

A bridge is being built across the Missouri River near Plattsmouth, Neb. Over-all length of the bridge is 2,400 ft. It spans the river for a distance of 1,500 ft. between towers. It will carry two 30-in. lines. The bridge is engineered by Mathews & Kenan and is

PILOT DITCHER digging to half the depth of the trench while the ditcher in the rear completes the trench down to 70 in. deep for a Northern Natural 20-in. loop in Iowa.



LIGHTNIN MIXERS in service at this pipe line tank farm keep B. S. & W. in uniform suspension in the crude. They eliminate the need for periodic tank cleanout.

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CONTROL B. S. & W. to get

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If yours is like many tank farms, bottom sludge may be stealing 12% of your tank storage capacity.

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You can save money four ways by using LIGHTNIN Mixers:

1. You increase tank capacity, because LIGHTNINs prevent bottom sludge buildup.

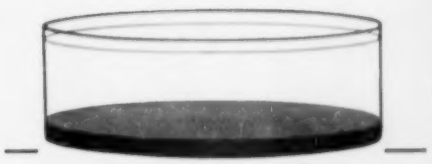
2. You save petroleum values often lost in the sludge (a 2-foot level of sludge in a 120-foot diameter tank may contain 4,000 barrels of merchantable material).

3. You save tank cleanout costs.

4. You eliminate tank downtime for cleaning.

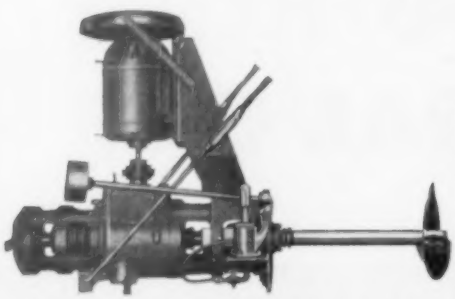
Because of these savings, LIGHTNIN Mixers have paid for themselves in as little as three weeks! We can show you figures to prove this.

Be sure to get LIGHTNIN Mixers—they're *guaranteed* to do the job right. Full satisfaction—or your money back. This unique guarantee is backed by thousands of successful installations in pipe line company and refinery tank farms. Sold by factory-trained engineers, experienced in serving the oil industry. Specify LIGHTNIN—and be sure.



BEFORE USING LIGHTNIN MIXERS
Diameter—120 ft.
B. S. & W. level—2 ft.
Storage capacity lost—4,000 bbls.

AFTER USING LIGHTNIN MIXERS
Diameter—120 ft.
B. S. & W. level—None
NO **storage capacity loss**



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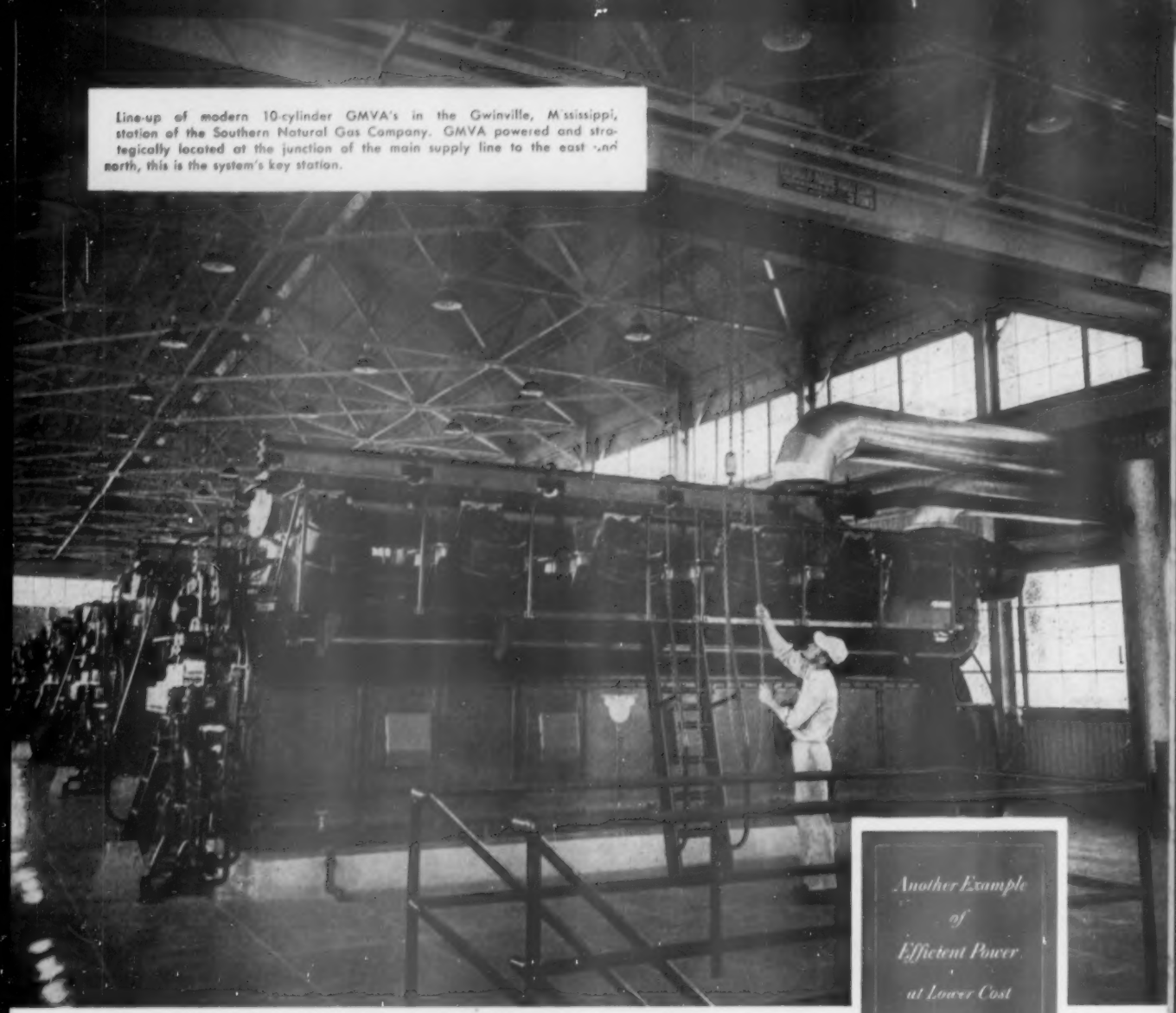

Line-up of modern 10-cylinder GMVA's in the Gwinville, Mississippi, station of the Southern Natural Gas Company. GMVA powered and strategically located at the junction of the main supply line to the east and north, this is the system's key station.

Another Example of Efficient Power at Lower Cost

Cooper-Bessemers total 700 years of service

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This horizontal Type 22 Cooper-Bessemer twin-tandem unit in the Tarrant, Alabama, compressor station dates back to 1937 when this, then modern, unit was first installed. Today, after 17 years, it continues to operate at top efficiency.

NINETY Cooper-Bessemer units — modern GMV's, and still newer GMVA's (providing still lower fuel consumption and decreased water requirements) and older style horizontals — have totaled more than 700 years of reliable compressor service for Southern Natural Gas Company.

The first of these units dates way back to 1930 — 24 years ago! And with each expansion more and more Cooper-Bessemers were added to Southern's system — proof of lasting satisfaction — evidence that you, too, can count on modern Cooper-Bessemers for year in, year out compressor service at the lowest operating costs known today.

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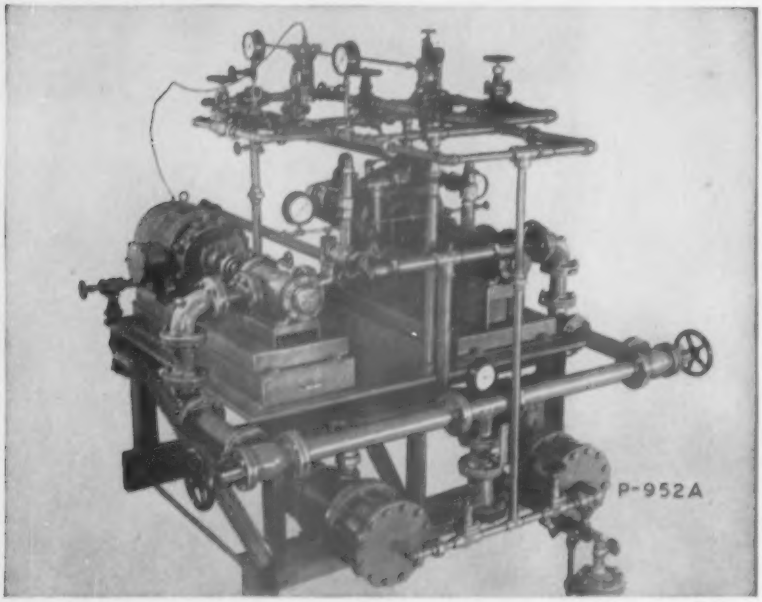

P-952A—Steam Turbine and Electric Motor drive gives flexibility in this compact Model P-ES2H size No. 25 unit.

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being built by Pittsburgh-Des Moines Steel Co.

Coating

For the past 10 years or so, Northern Natural has followed a policy of using mill-coated and yard-coated pipe for all lines of 12-in. and smaller diameter. While there is a difference in cost between the over-the-ditch method on one hand and the mill-and-yard-coating method on the other, the latter has been preferred because it appears to the management to expedite construction progress and makes it possible to procure a high-quality paint job.

The only exception to the policy of having all pipe coated over the ditch above 12 in. in diameter is a single 5-mile, 16-in. yard job this year which is yard coated.

Where coal-tar coating is used, the general practice has been to use middle-grade enamel reinforced with 18-mil. glass mat. North of Omaha it is wrapped with 7½-lb. glass-reinforced felt to withstand soil stress. Until this year the general policy of the company has been to coat with coal tar.

Except for some earlier experiments at Hugoton, Northern Natural is using asphalt coating for the first time this year. The 1954 application is on the Waterloo-Dubuque, Iowa, 88-mile, 16-in. line where Lion Refining Co. (licensee Husky Refining Co., Cody, Wyo.) furnishes desalted asphalt coating. It is applied over the ditch with glass-mat reinforcement and a wrap of asphalt-impregnated felt. Low cost of material and 8 to 25 per cent more coverage on the line have made asphalt coating attractive.

Coverage of pipe with coal tar has greatly increased recently with development of new spray-type coating machines. The company has observed that this new equipment has saved 100 tons on 90 miles of 30-in. There has been a marked reduction of spillage on the ground with the new dope equipment.

Welding Progress

Construction reports coming to Northern Natural this summer show that a good average day's output for 30-in. pipe in favorable terrain is about 10,000 ft. per day. There have been some high days of 12,000 ft. In western Iowa, where the terrain has been rough, output for 30-in. pipe has been 6,000 ft. per day. Good output per spread laying 20-in. has been also 12,000 ft. per day. For diameters from 16 to 20 in., output has generally been from 7,000 to 12,000 ft. per day.

For welding 30-in. pipe, Midwestern Constructors, Inc., has had four string-

TECHNICIAN at controls of X-ray equipment for radiographic inspection of welding.

er-bead welders working simultaneously and six hot-pass welders.

The increase in efficiency of spread operations this year has been observed by Northern Natural in the reduction of employes per spread. For a 30-in. spread there are 170 men, including 29 welders; for a 20-in. spread, 150 men including 14 to 15 welders, and for a 16-in. spread, 130 men, including 13 welders.

At the Ogden-Waterloo, Iowa, 93-mile, 20-in. line laid by Hallmac Construction Co., ditching was being done with two No. 320 Cleveland ditchers when the author contacted the work near Eldora, Iowa. The pilot ditcher ahead worked only in the daytime and dug to depths of 30 to 40-in. The following ditcher, working day and night, dug to 68 to 70-in. for the finished ditch.

This spread was welding 10,000 to 12,000 ft. per day with three stringer-bead welders. (The third welder was to spell off.) There were four hot-pass welders. Two of the four spelled off. The 300-amp. welding units for stringer bead and hot pass welding were diesel driven.

Construction Practices

Although the contractors are given the option of cradling into the ditch, none of them has done so this year on the company's construction.

Cover on large pipe is 40 in. and on small pipe, 36 in. Ditch width is of the usual dimensions of 1 ft. more than the pipe diameter. In cleanup, a 12-in. crown is left over the pipe.

Construction Projects

For Northern Natural Gas Co.'s expansion program this year, more than 960 miles of pipe is being laid. The principal projects are as follows:

North from Clifton, Kan., 90 miles, 30-in. contracted by Midwestern Constructors, Inc.

South of Clifton, Kan., 90 miles of 30-in. contracted by Midwestern Constructors, Inc.

North of Sioux City, Iowa, 10½ miles, 24 and 26-in., and Paulina, Iowa, to Sioux Falls, S. D., 65 miles, 20 and 24-in., both contracted by R. H. Fulton & Co.

Ogden-Waterloo, Iowa, 90 miles, 20-in., contracted by Hallmac Construction Co.

Waterloo-Dubuque, Iowa, 88 miles, 16-in., contracted by Engineering Construction Co.

Spread No. 1—Minnesota branch lines, 118 miles, 2 to 12-in., contracted by G. G. Griffis, Inc.

Spread No. 2—North Iowa branch lines, 96 miles, 2 to 12-in., contracted by O. R. Burden Construction Co.

Spread No. 3—Central Iowa branch lines, 63 miles, 2 to 10-in., contracted by Pipe Line Welding Co.

Spread No. 4—South Central Iowa branch lines, 92 miles, 2 to 6-in., contracted by G. G. Griffis, Inc.

Spread No. 5—Western Iowa branch lines, 90 miles, 2 to 10-in., contracted by Brodie Construction Co.

Spread No. 6—Minnesota, South Dakota, and Nebraska branch lines, 70 miles, 2 to 6-in., contracted by Troth Construction Co.

Cimarron River crossing, Ash'and, Kans., 30-in., contracted by Lone Star Constructors.

Over 10 other river crossings in Kansas, Nebraska, and Iowa.

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THE 80,000-BBL. TANK rests in its new location after being floated from the old location near the dikes at left.

Sohio encountered unusual problems in

Floating a Tank on a Hilltop

by R. S. Kestner

ALTHOUGH relocating large storage tanks by the floatation method to nearby sites is now commonplace in the petroleum industry, the job of moving a 120 by 40-ft., 80,000-bbl., cone-roof tank along the crest of a rocky ridge posed a variety of problems for Sohio Petroleum Co., a subsidiary of Standard Oil Co. (Ohio).

The all-welded steel tank, used in petroleum-distillate storage, was erected on the south end of a north-south ridge. The ridge is approximately 250 ft. in width at the crest and extends 1,000 ft. north to buttress the bluffs of the Ohio River near Bromley, Ky. It is separated from neighboring ridges to the east and west by valleys 60 ft. below the crest, and falls off abruptly to the south 250 ft. down to a water course from the surrounding hills to the Ohio River.

In its original location the tank was erected on a sand foundation with a 3-ft. asphalt-treated apron extending around the shell. The tank basin was excavated out of the hilltop in a crescent shape 180 ft. across with the open end toward the east. Limited space on the ridge made it necessary to use the tank basin to confine and divert any tank spillage into a primary basin located in a valley to the east of the tank. Slippage of the dike at the south slope was an expensive maintenance problem. To correct this condition the tank was moved to a new location on the hilltop so that the dike could be relocated to a better position.

Preliminary work . . . The planning phase of the relocation project involved calculation of the forces required to start and control or stop the movement of the tank and the reactions, relative to the line of movement, to be caused by wind forces on the tank after it was afloat. From these data the arrangement of towing and guiding cables were shown on a plat of the site, together with the locations of the winching equipment and arresting bumpers.

To provide a suitable basin for the new tank location, 15,325 cu. yds. of sandy loam and limestone was excavated. This elongated the original crescent-shaped tank basin by about 135 ft. in a northerly direction.

In preparation for work in the interior, the tank was thoroughly cleaned. Manhole covers in the shell and roof were removed and the bottom residue was stripped, using two gasoline-engine-driven centrifugal pumps. Rubber squeegees were used to give the bottom plates a final scraping.

After the tank was found to be gas-free, a thorough inspection was made of the bottom plates, roof, rafters, and column bases. The column bases and channels were tack-welded to prevent the possibility of the bases sliding when the tank started to float. The tank builder, and other companies having tank-floating experience, were of the opinion that it was not necessary to use additional shell and tank bottom bracing or reinforcement.

Following the interior inspection and work on the tank, the automatic gage connection was removed and the tank line was disconnected, leaving the tank valve on the fill nozzle. The tank line was used in filling the basin with water. To keep the discharge water from

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HEAVY TIMBER BUMPERS are set in place to stop tank at desired new location.

NEW GRADE COMPLETED, bumpers set, basin ready to be filled with water to start pulling operation.

MOVING OPERATION shows guide lines, tow lines, and restraining bumpers.

IN PLACE against bumpers at new location. Man in water preceded tank during move to check clearance.

Construction Section

damaging the new foundation, the tank line was cut short to the point where it entered the tank basin.

New grade established . . . While the tank line work was in progress, a survey party established and set grade stakes for the proposed tank foundation. All of the grade stakes used were placed in holes previously made with a pneumatic rock drill because the new basin floor and the dike slopes were composed entirely of limestone slabs. The survey crew also marked the location for the timber bumpers and the posts used to secure the guide lines.

Four hundred ninety-six tons of two-wash, pea-size, ⅛ to ¾-in. gradation gravel was trucked to the job. The trucks were towed up the hill to the tank site with a tractor. Rough grading of the gravel was done with a bulldozer and the finished grade was hand raked. To maintain the tank pad finish grade, during the moving operation, the pad surface was "shot" with cutback asphalt.

Heavy bumpers set . . . The bumpers were constructed from 12 by 12-in. timbers, with a horizontal base member supporting two 3-ft. verticals braced by horizontal and angle struts to the base. Individual members of each bumper were held in place with 12 by 12 by ¼-in. steel plates on each side of the joint and ½ by 15-in. steel bolts. This type of joint allowed a certain amount of give or flexibility in the bumper at the time of impact with the tank which prevented distortion of the shell.

One bumper was placed with the base timber against the limestone dike and directly in line with the north-south centerline of the proposed tank location. Another was similarly set with a radial offset of 36° to the right, and a third 24° to the left of the centerline bumper. All three bumpers were weighted with limestone slabs to prevent possible shifting while the basin was filling with water.

Tow cables attached . . . Four 12 by 12 by ½-in. steel plates, drilled with 1½-in. holes, were welded to the tank shell in a vertical position, 5 ft. up from the tank bottom. One and one-eighth-inch steel shackles were bolted to the plates. One plate was located on the north-south centerline of the tank and offset about 6 in. from the anticipated point of contact between the bumper and the shell. The other three plates quartered the circumference of the tank shell.

The first-mentioned plate was the point of attachment for the ¾-in. cable from the winch on a tow tractor. A ½-in. cable from the front-end winch of a 1-ton truck was attached to the south shackle to serve as a restraining line and helped to maintain control during the moving operation.

The east and west shackles were threaded with ¾-in. cables. Each cable was about 250 ft. in length and was secured at either end to 8 by 8 in. timbers 8 ft. long that were set in 4 ft. of concrete, the distance between the parallel cables being the exact diameter of the tank. They formed a guided path for the tank from the old to the new foundations.

Approximately 500 cu. yd. of earth, excavated in enlarging the basin, was used to build a temporary dike for containing the water during the relocation of the tank. Since this was on the east side of the ridge and considered the weakest point in the hilltop basin, a ¾-in. cable from a winch on a 2-ton truck was also attached to the west shackle. This unit was added as a safety measure; in the event of failure of the temporary dike, it would supplement the holding action of the guide cables.

The final step in the preparation of the tank was the marking of 3-ft. gages on the tank shell. Six gages were inscribed at various vantage points on the shell to show the depth of submergence.

Prior to the moving date, the asphalt apron around the original foundation was removed and several shallow pits were dug adjacent to the shell of the tank. In addition, approximately 6,000 bbl. of water was pumped into the basin and allowed to soak the area overnight. The reasons for these steps were:

1. Destroying the asphalt apron increased the porosity of the area around the tank and also eliminated the possibility of the asphalt hindering the buoyancy of the tank.

2. Soaking the basin allowed the water thoroughly to penetrate the sand foundation. This in turn allowed the tank to leave the foundation as uniformly as possible, preventing any undue stress in the shell plates. Furthermore, the soaking period also tested the ability of the basin and temporary dike to retain water.

Floating operation . . . On moving day the weather was clear and hot. A steady 10-m.p.h. wind was coming out of the north with guests up to 20 m.p.h. Water was again started into the basin at a 1,700-bbl. per hour rate. The tank left the old foundation when there was 1½ ft. of water in the basin. It raised without any apparent strain; however, there were metallic rumblings as the bottom and roof plates arched. Water was pumped into the basin until a depth check showed there was a min-

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THE AUTHOR

R. S. Kestner joined Sohio Petroleum Co. in 1947 as an engineer. He was appointed senior engineer in 1950 and continued in this capacity until July 1954. At this time he became group supervisor in charge of the construction section of the engineering department in Sohio's transportation department. He is a mechanical-engineering graduate of Michigan College of Mining and Technology.

imum of 28 in. at the highest point in the basin. The water was then stopped and the tractor winch started pulling on the tank.

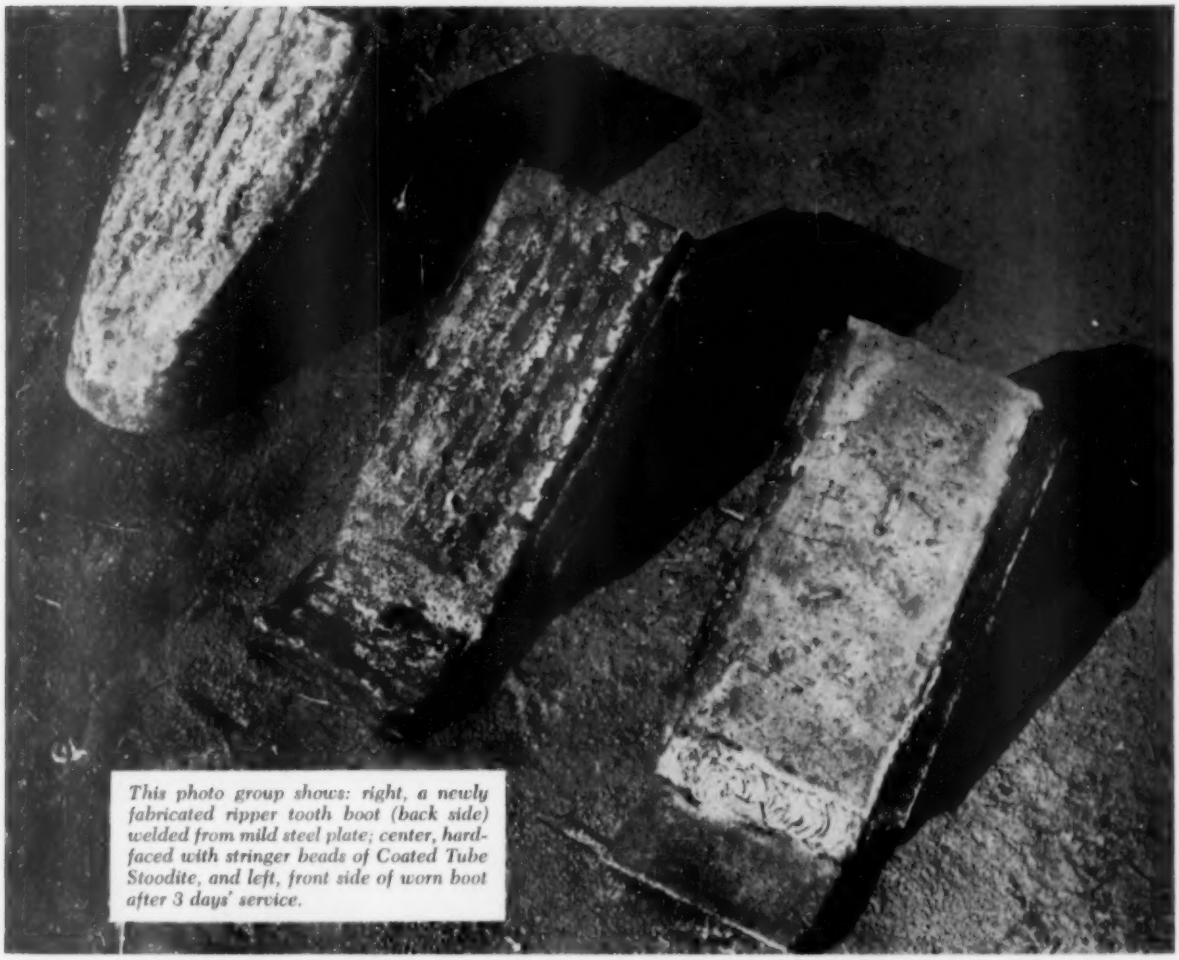
Thirty minutes later the tank had been moved 130 ft. and was floating in its new location against the timber bumpers. While the tank was moving, one man was assigned the duty of checking the clearance between the bottom of the tank and the basin to be certain that the tank had sufficient clearance. The tank was restrained in its relocated position with the towing and guiding cables until the water was drained from the basin area.

Move over tank tests O.K. . . . After the tank had settled on the new foundation, a visual inspection was made of the inside structural members and the roof. A level survey of the tank bottom indicated the conical shape of the foundation was not disturbed and that the outside bottom plate chime showed little variance in elevation. Magnafluxing revealed there were no cracks in the bottom-to-shell circumferential welds. The same was true on the bottom 10 in. of each vertical seam in the first course and also on each breakdown. The tank was cold-water hydrostatic tested to the full working height. After this test, the water was dumped and the tank was again ready for service.

Floatation can be a safe, dependable and economical method for moving storage tanks a reasonable distance. In this case the saving in labor costs, not including the earthwork or tank-foundation construction, was nearly 60 per cent of the next most economical method considered.

The entire moving operation, excluding the earthwork, was completed in 12 days by the Sohio construction crew which had a complement of eight men for this particular assignment.

There is much to be said for adequate scheduling and planning on a job of this nature, but it is no substitute for good, sound field supervision and competent personnel.



This photo group shows: right, a newly fabricated ripper tooth boot (back side) welded from mild steel plate; center, hard-faced with stringer beads of Coated Tube Stoodite, and left, front side of worn boot after 3 days' service.

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Depth at which ripper operates is evident by length of standard.

The ripper on this job is designed for easy maintenance; boot type point and adapter are replaceable. The points are fabricated from mild steel plate in the

Close-up shows point attached to tooth adapter. Entire tooth is hard-faced with Coated Tube Stoodite.

division headquarters maintenance shop of the pipeline company handling the job, Engineers Limited Pipeline Co., Bakersfield, California. All four sides are hard-faced with Coated Tube Stoodite before being placed in service.

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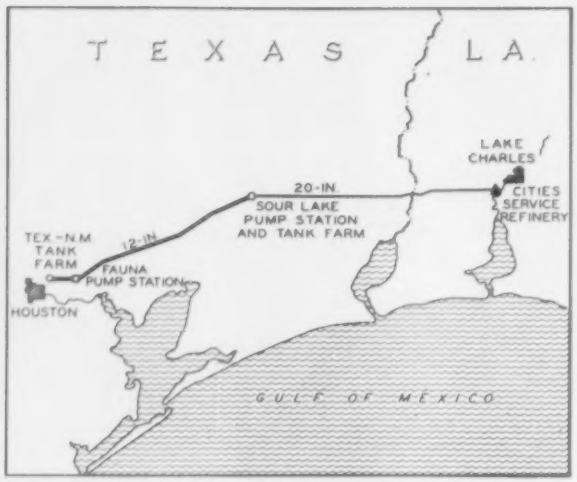
Construction of Cities Service's new 12-in. line became "Operation Mud" as spring rains made a quagmire of the right-of-way.



Route of the 60-mile 12-in. line. Crude will be delivered into the existing 20-in. line to Lake Charles.

Needed negative buoyancy was provided by heavy-wall pipe on crossings of the Trinity and San Jacinto rivers.

Welders fabricate roof pontoons for the new type tanks used at the Fauna tank farm.

Cities Service Lays Gulf Coast Line

Features of the new system include use of yard-applied asphalt coating in the line construction plus sloping tank bottoms and automatic samplers for the one-man operated station.

by Harry Nelson

ON August 2, 1954, Cities Service Pipe Line Co. placed in operation its new 12-in. crude line between Houston and Sour Lake, Tex. At Sour Lake the new 12-in. connects to an existing 20-in. line serving Cities Service Refining Corp.'s big refinery at Lake Charles, La. In the Houston area, oil can be received from Texas-New Mexico Pipe Line Co., Service Pipe Line Co., and Humble Pipe Line Co. A new pump station and tank farm were built near Fauna, Tex., 6 miles east of Houston. Humble will deliver into the Fauna tanks whereas Service Pipe Line and Texas-New Mexico will deliver directly into the line west of Fauna, with volume measurements being made by gaging of the Fauna tanks.

Author is manager of operations, Cities Service Pipe Line Co., Bartlesville, Okla.

Line construction . . . The new 12-in. line is approximately 60 miles in length and is constructed of electric-welded pipe of .250-in. wall thickness, except for the river crossings. These were laid with .500-in. wall pipe which will provide the necessary negative buoyancy. Pipe in the western half of the line is 5LX-46 while that in the eastern half is 5LX-42.

All pipe was yard-coated at Houston.

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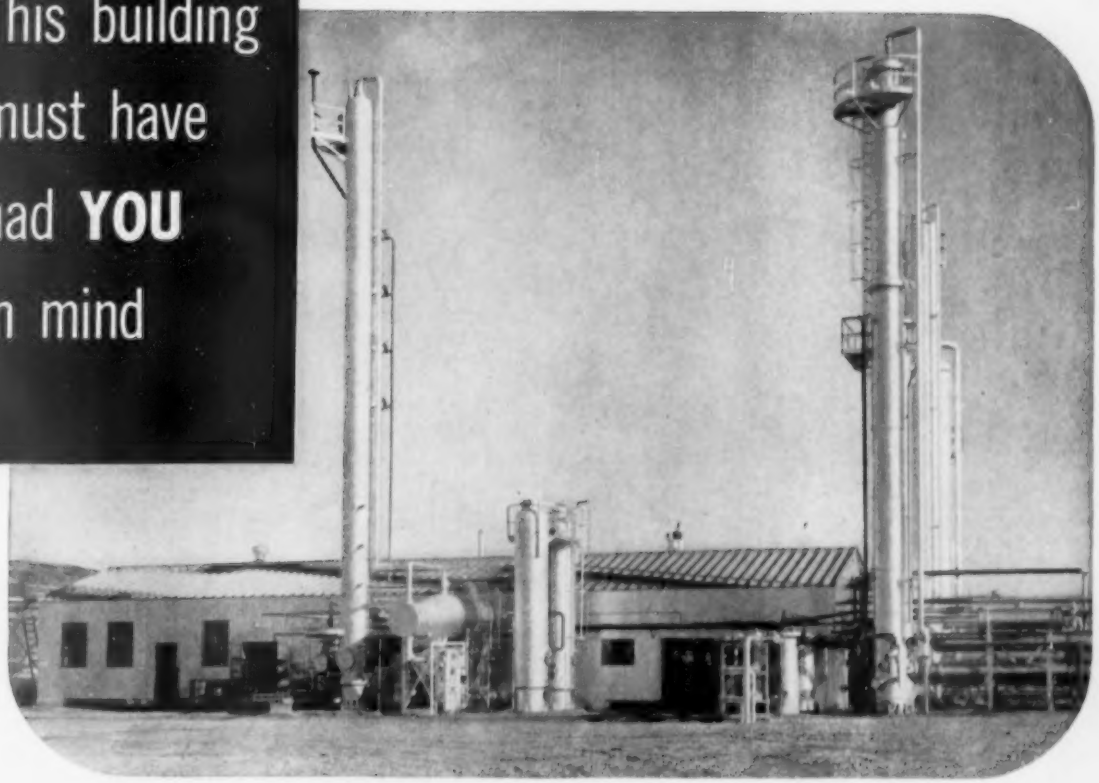

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Construction Section

The coating consisted of grit blast cleaning, application of primer, followed by a 3/32-in. minimum coat of hot asphalt, and a wrapping consisting of parallel-reinforced, glass-fiber inner wrap, 15-lb. perforated asbestos felt, and kraft paper. The purpose of the kraft paper was to provide some measure of abrasion protection during the hauling and stringing, and to facilitate the finding of damaged spots by visual inspection.

The asphalt coating withstood the hauling and handling remarkably well. In fact, most of the bends were made without causing jeeps or other damage to the coating. The welds were coated by filling "field jointers" with hot asphalt. The specifications called for a round-bottom ditch in order to provide maximum uniform bearing for the coating.

Other than mud, no particular problems were encountered in the line construction. One 12-mile stretch of swampy wooded area near Sour Lake had no access roads and as a result of stringing and hauling, the right-of-way became a sea of mud that remained boggy even after the surrounding areas dried.

Two navigable rivers, the San Jacinto and Trinity, one navigable bayou, and nine irrigation canals were crossed. The line was laid under the streams and over eight of the canals. The canal crossings were supported on pipe A-frames, and cased in 16-in. The canal approaches were made with 30° long-radius tube turns.

New-type tanks . . . Six pontoon-roof, 120,000-bbl. tanks of a new design were built at Fauna station. The tank bottoms are shaped in the form of a truncated cone, sloping 20 in. between the shell and center. A combination suction and fill line extends to the tank center and downward to within 4½ in. of the bottom. A water drawoff also extends to the center of the tank and downward to within 1½ in. of the bottom. The suction line is fitted with two belled out intake ports and vanes to prevent vortexes.

The sloping tank bottom will not only permit pumping the tank down to a low level when necessary to change from sour-crude to sweet-crude service, but will minimize the corrosion problem. Obviously, there can never be more than 4½ in. of water present. By eliminating most of the water, most of the corrosion is also eliminated. The bottom is coated only in the center portion below the 4½ in. level, with a cold mastic application. Two magnesium anodes of the "toadstool" de-

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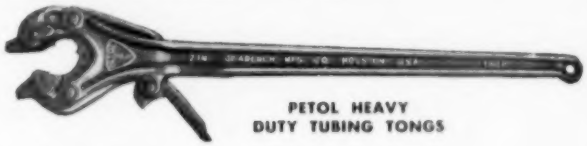

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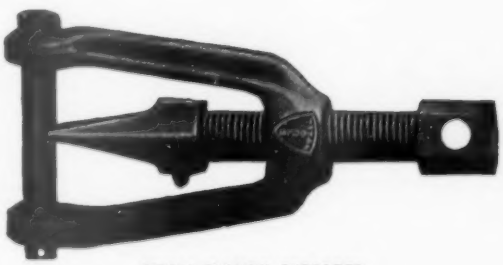

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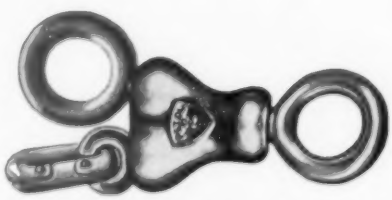

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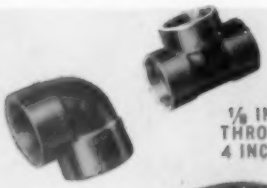

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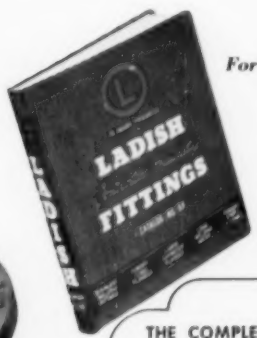

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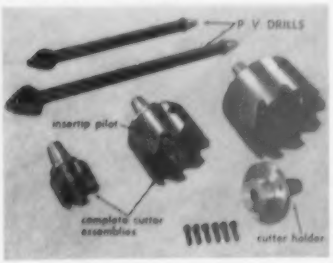

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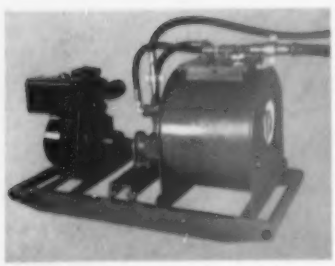

UPPER PHOTO: COMPACT HYDRAULIC MOTOR & CONTROL VALVE REPLACE AIR MOTOR ON TAPPING MACHINE.

LOWER PHOTO: ENGINE-DRIVEN HYDRAULIC PUMP, SKID MOUNTED WITH FLUID TANK, SUPPLIES POWER TO HYDRAULIC MOTOR THROUGH 50 FT. HOSES.

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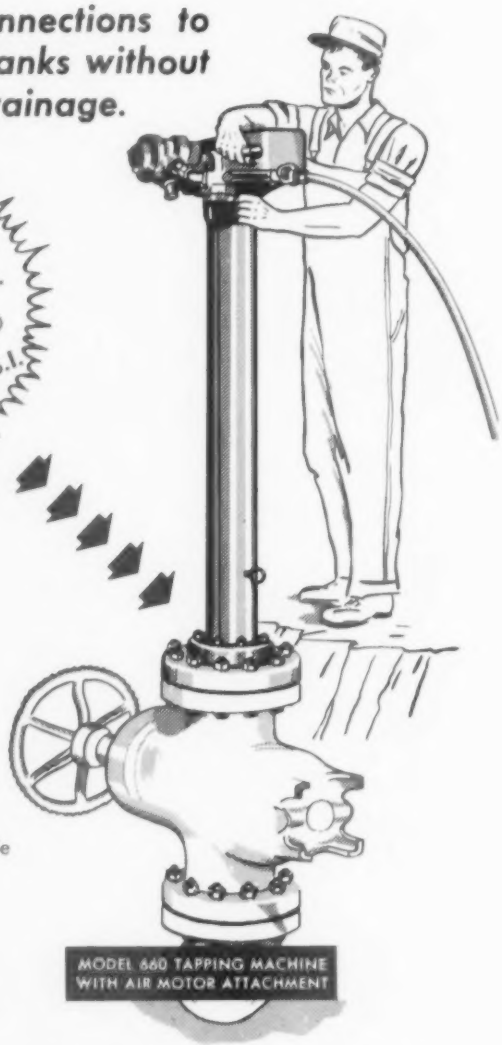
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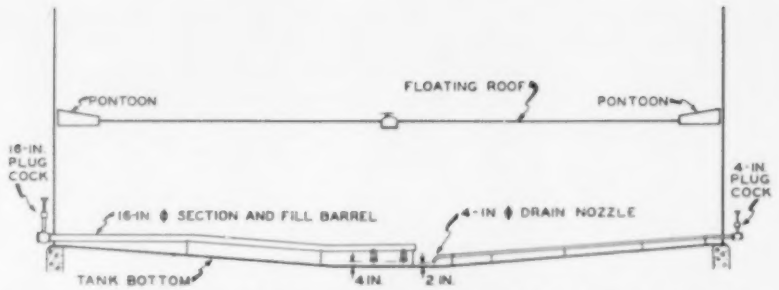

Cross-section of the new type tanks. Position of suction and fill line assures minimum accumulation of b.s. and w.

sign supplement the coating in providing additional protection to the inside tank bottom.

All outside surfaces of the floating roof and the inside of the top shell ring are treated with one coat of a chemically cured, zinc-base protective coating. The rim plates are coated with a five-coat system of catalyzed epoxy. Microballoons will be added to the oil surface between the floating roof and the shell as an extra protection against corrosion and vapor loss. The outside surfaces of the tank shell will be painted white with a combination of an epoxy primer and two vinyl finish coats.

Each tank rests on a reinforced concrete ring padded with asphalt and felt. The undersides of the tank bottoms were not coated but will be protected by a cathodic system. The area between the tanks and the firewalls is very carefully graded to prevent the tanks from floating in the event of abnormally heavy rainfall while the tanks are empty. Also, exceptionally large drain lines through the firewalls have been provided.

Manifold and station . . . A single line to each tank serves as both a fill and suction line. Each tank line terminates at a common header at the station manifold. By using O-ring-type gates in the manifold with tattle-tale pressure taps on each one, the need for double gates was eliminated, resulting in a saving of 12 gates. These particular valves can be operated manually with very little effort, so an additional saving resulted from eliminating devices for automatic operation.

Automatic samplers are provided for each incoming stream as well as the outgoing stream. Automatic, remote-reading tank gages are the type that show the gage readings in colored lights on a panel located in the station office.

The pump station has two 700-hp. motor-driven centrifugal pumps. When operated in series the average winter pumping capacity will be 65,000 bbl. daily. By installing larger impellers the winter capacity can be increased to 69,000 bbl. daily. The station is designed for one-man operation.

The modern station building was designed by Henry Dreyfus. A large open breezeway covers the main units, thus eliminating expensive ventilating equipment. A large pylon prominently displays the company emblem. Rooms off each end of the breezeway house the office, storerooms, and toilet facilities.

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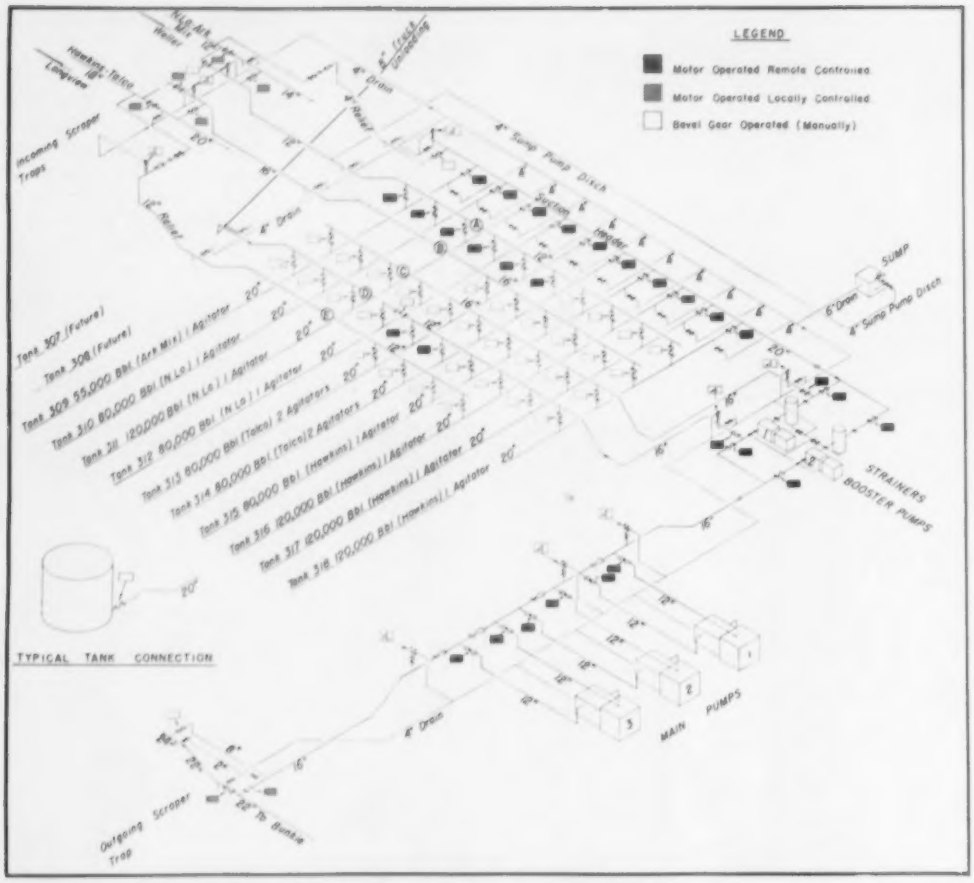
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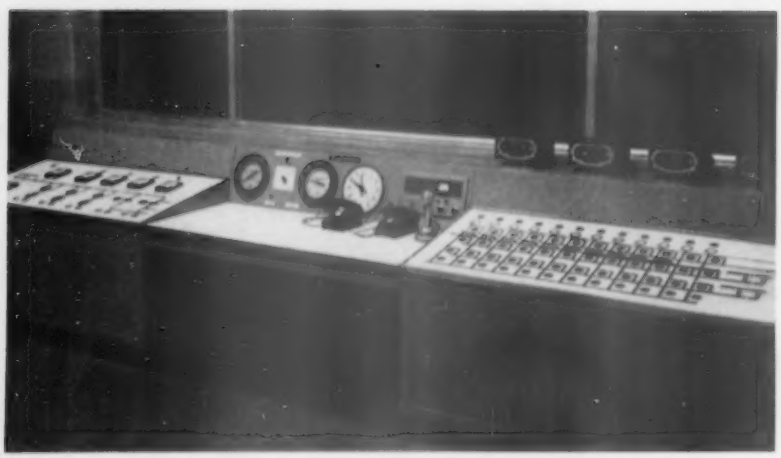
Tank 308 (Future)
Tank 309 55,000 Bbl. (Arc Mix) | Agitator
Tank 310 80,000 Bbl. (N.Lo.) | Agitator
Tank 311 120,000 Bbl. (N.Lo.) | Agitator
Tank 312 80,000 Bbl. (N.Lo.) | Agitator
Tank 313 80,000 Bbl. (Tolco) 2 Agitators
Tank 314 80,000 Bbl. (Tolco) 2 Agitators
Tank 315 80,000 Bbl. (Hawkins) | Agitator
Tank 316 120,000 Bbl. (Hawkins) | Agitator
Tank 317 120,000 Bbl. (Hawkins) | Agitator
Tank 318 120,000 Bbl. (Hawkins) | Agitator
STRAINERS
BOOSTER PUMPS
TYPICAL TANK CONNECTION
MAIN PUMPS
6" Drain
Outgoing Scraper Trap
20" To Banks

FLOW DIAGRAM of Finney station. Note the large number of power-operated valves.

Interstate's Finney Station . . .

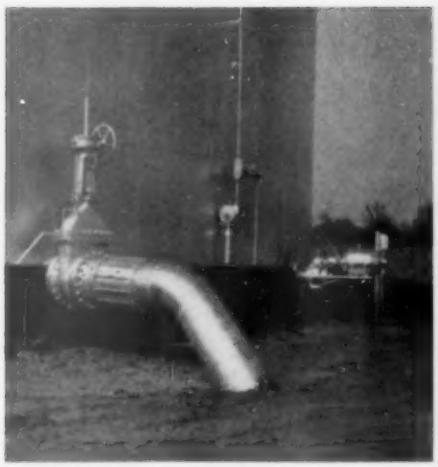
Pipeline Instrumentation—1954 Model



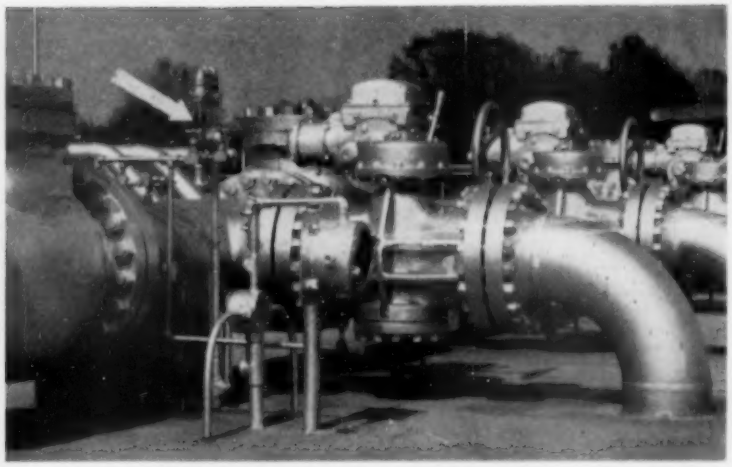
CONTROL CONSOLE has the flow panel on left, tank-farm layout on right, desk with radio, clock, and tank gages in center. Fig. 1.

by Marvin J. Hamilton and Charles F. Barnard

Do the job with power and control it automatically. That's the basic idea behind the great quantity and many types of automatic control and measuring devices employed in the operation of this 4,700-hp. push-button crude-oil station.



AUTOMATIC TANK-GAGE transmitters and fan-type agitators are installed on all tanks. Fig. 2.



PRESSURE TRANSDUCER, in the form of an SR-4 strain gage (arrow) and a mercury switch, guards against high station-discharge pressure. Fig. 3.

Finney Station . . . Where and what it is

FINNEY Station, 12 miles south of Shreveport, is the initial station of Interstate Oil Pipe Line Co.'s main-line system to Baton Rouge. Oil is received here from Interstate's Magnolia, Ark., and Shreveport districts through a 12-in. line, and from Humble Pipe Line Co. through an 18-in. line. Smaller quantities are hauled in by truck. This oil is pumped south to Bunkie station through 115.75 miles of 22-in., 16.61 miles of looped 12-in., and 1.13 miles of single 12-in. line.

The station proper presently consists of nine floating-roof tanks with a total capacity of 815,000 bbl., a manifold, two single-stage, centrifugal booster pumps, each with its 100-hp., weather-protected electric motor, three main units, each consisting of a 1,500-hp., 3,600-r.p.m., weather-protected electric motor and a two-stage centrifugal pump, outgoing and incoming scraper traps, truck-unloading facilities, an office building, and necessary electrical control equipment. All of the pumping units are outdoors. The office building serves to house the control equipment, chief engineer's office, operating room, sample room, office for the Humble gagers, bathroom, room for the air-conditioning facilities, and a warehouse.

Control Section

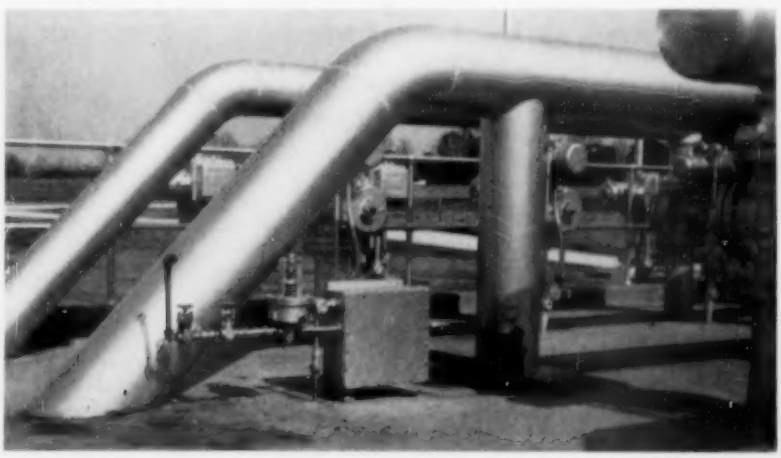
WHEN Finney station went on stream in the last days of 1953, Interstate Oil Pipe Line Co. began its first operating experience with one of the push-button, semiautomatic electrical-centrifugal pumping stations which are becoming popular in the industry. The trend in the pipeline industry, as in other industrial processes, is to use electrical and mechanical agencies not only to do the physical work required in such processes, but to also observe, inspect, control, and record wherever the nature of the process permits.

It is with these latter functions that we are concerned, for if a mechanical device can relieve an employe of his routine duties, this employe is free to apply himself to some other, more important job and individual productivity is increased by that much.

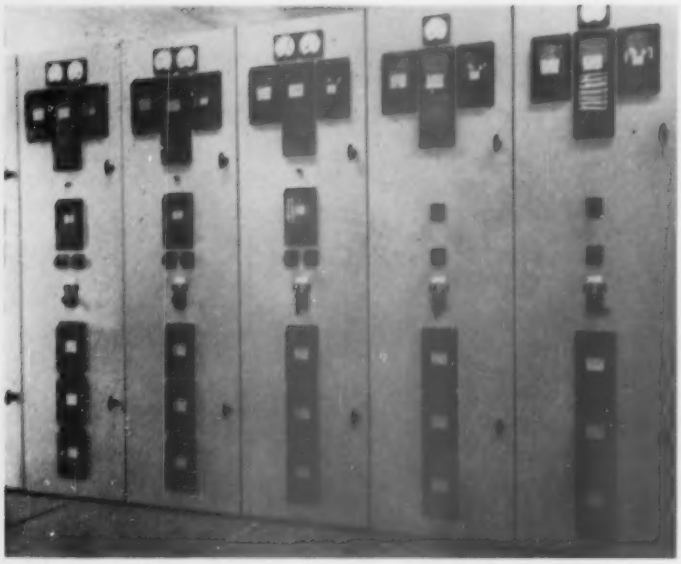
We have grouped all Finney station devices under the heading "measuring devices". To present the discussion of each in a logical sequence, we have arranged these instruments in outline form, grouped in two classes:

1. Instruments which measure those quantities relating directly to pumping, receipt, and delivery of oil. In this class are automatic tank gages, truck-delivery metering facilities, pressure instrumentation, remote-reading averaging thermometers, automatic samplers, and the control desk itself where all these devices give a visual indication of the quantities they measure. These will be described under "Oil-Measuring Devices".

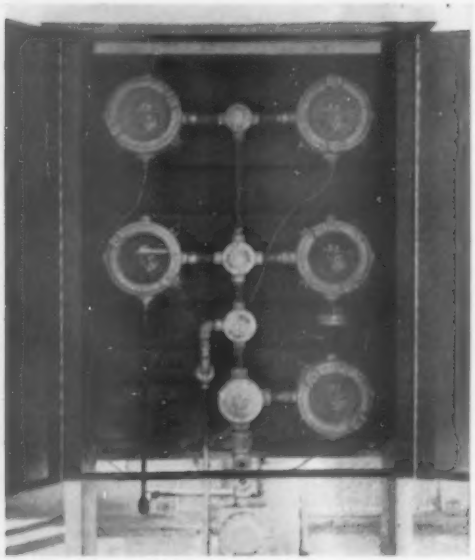
2. Other measuring elements which are concerned primarily with sensing conditions in the oil and in the equipment in order to give an alarm or shut down the station in the event of some abnormal condition which could be dangerous to personnel or equipment. These are grouped under "Protective and Control Devices".



AUTOMATIC SAMPLER on one of the incoming lines. Time interval between samples may be varied from 1 to 30 minutes. Fig. 4.



SWITCHGEAR for main units and booster pumps. These cubicles house ammeters, winding-temperature meters and other protective relays. Fig. 5.



MERCURY SWITCHES for individual units. Pump and motor are to the rear of the cabinet. Fig. 6.

Control Section

Oil-Measuring Devices

The control console, Fig. 1, is an integral part of nearly all measuring devices used at Finney station. It is a long, desk-like structure with the manifold, tanks, and pumping units represented schematically on its surfaces. Colored lights indicate operation of motors, positions of valves and, when necessary, the nature and location of abnormal operating conditions.

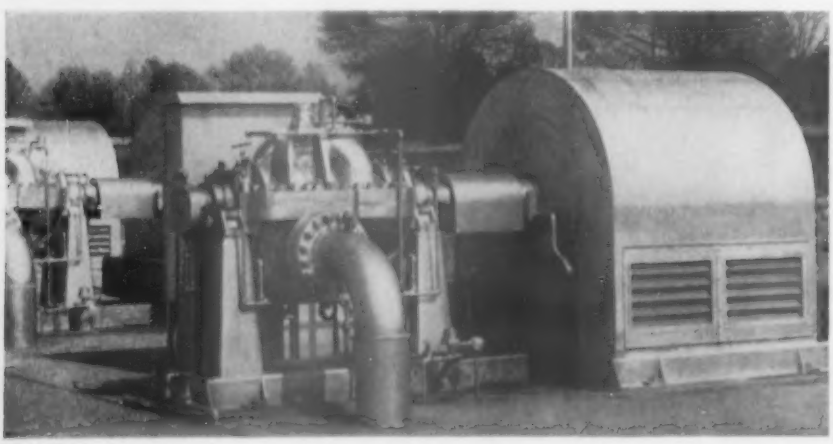
The tank gages, truck-unloading meters, pressure gages, clock, and radio are mounted integrally with the desk, and when the averaging thermometers are installed, it is planned that the remote indicator, too, be installed on the desk. The gas analyzer is mounted in the wall behind the desk, since it comes in a large upright case.

To avoid having an excessively large number of push buttons on the desk, "Select-O-Push" push buttons were used for motor-operated valve control. This device combines the functions of a push button and a selector switch insofar as a single "button" can be made to "open", "close", or "stop" a valve depending on which way the arrowhead-shaped button is pointing when it is depressed. These Select-O-Push buttons are recessed so that the top of the button is flush with the top of the desk.

Automatic tank gages . . . The tank gages, Figs. 1 and 2, used at Finney station are of the remote-reading, double-selsyn type. The installation consists of individual gages and transmitters at each tank and a common receiver unit at the control console. The gage at the tank is operated by a perforated tape and a wire fastened to the tank floating roof, and may be read either directly at the ground level of the tank or remotely from the station console.

The remote reading is made possible by two transmitter selsyns ("foot" transmitter and "inch" transmitter) at the tank, which cause the foot and inch receiver selsyns to rotate in step with the transmitter selsyns. A selector switch and relay bank connects the receiver to the tank to be gaged.

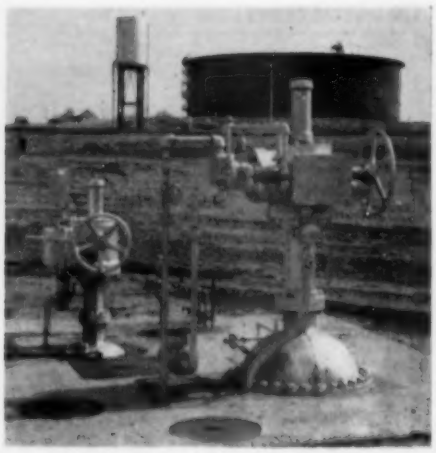
So far, these gages have been very satisfactory with no abnormal or inaccurate operation. However, the relay units required graphite lubrication to overcome an initial tendency for some



VIBRATION RELAY to protect pump bearings is mounted on top of pump case as shown in this view. Fig. 7.

GAS ANALYZER makes analyses by new-type electrical method. Fig. 8.

SAMPLING POINT for gas analyzer is this funnel-like object mounted beneath booster pump. Fig. 9.



HYDRAULICALLY OPERATED VALVE is on outgoing scraper trap. Fig. 10.

Control Section

of the relays to stick. Portable two-way radio was very useful during the calibration of these gages.

Truck-unloading meters . . . The truck deliveries at Finney station are measured by 2½-in. positive displacement meters, temperature compensated to 60° F. The readings appear on counters at the meters and some 500 ft. away at the control console. The remote-reading counter is synchronized with the counter at the meter by means of a selsyn transmitter and a selsyn receiver.

Pressure instrumentation . . . To avoid placing high-pressure oil lines in the control console, the pressure indications for suction pressure and station discharge pressure are derived by electrical means. The system consists of an SR-4 strain gage, (see Fig. 3), a resistance coupled amplifier, and a 0-5-volt 60-cycle meter for direct readings of pounds per square inch and a recorder which provides a continuous graphical record of station suction and discharge pressures.

The heart of the system and the only unit in contact with the oil is the SR-4 strain-gage pressure cell on the oil line which, by means of a resistance bridge, modulates a 12-volt 60-cycle current from the power supply in accordance with the pressure in the cell. This resultant voltage is very small, something in the order of 0.012 volts when the line pressure is its rated maximum, and must be amplified before it can operate a meter.

This amplification is accomplished at the control console by means of a conventional, two-stage, audio-type amplifier operating conservatively with a large amount of negative feed back for stability and linearity. This output is about 5 volts at the rated maximum pressure and the meter reads directly in pounds per square inch instead of volts.

A three-position "calibrate-zero-operate" switch provides for calibration against a dead-weight tester. The "calibrate" position allows the operator to detect and correct any routine "drift" of the system without disturbing the calibration.

It was originally intended that the pressure gages for the station suction and first-stage discharge should have their pressure zeroes located at a point on the dial one-sixth of the way between the gage's mechanical zero and its full-scale position. We found it possible to calibrate the amplifier for the two end points, i.e., so that the one-sixth and full-scale position would correspond to zero and maximum pressure, but it was impossible to correct an inherent nonlinearity at intermediate points. When the mechanical zero was used as the pressure zero, this nonlinearity was not apparent. Since no difficulty was experienced with other gages which had coinciding pressure and mechanical zeroes, it was decided

NIGHT VIEW of station shows the effectiveness of the mercury-vapor lighting facilities. Fig. 11.

to order similar faces for the two gages just discussed.

The dual pressure recorder shows station suction and discharge pressures; it operates directly from other SR-4 pressure cells and has its own detection and amplification equipment. The bridge in the strain-gage cell and a bridge in the recorder are excited from the same 1,000-cycle source in the power supply. Initially, both bridges are balanced; that is, the midpoints of both bridges are at the same potential.

Any change in pressure in the strain-gage cell will tend to cause a difference in the midpoints of the two bridges, but this unbalance is detected and amplified to rotate a variable capacitor in one arm of the internal bridge so that both bridges are unbalanced to the same degree and the net unbalance is zero, and a state of equilibrium exists once more.

A pen is connected mechanically to the rotor of the variable capacitor so that a record is kept of pressure variations. The station suction pressure and the station discharge pressure are both recorded on the same chart.

The pressure recorder is not so subject to drift as the pressure indicating system, so the initial dead-weight calibration should last indefinitely. However, a secondary means of checking calibration at the zero and full-scale points on the recorder is available. This secondary check is a precision resistance unit which, when attached in place of the pressure cell, gives voltage outputs corresponding to readings of zero and full scale.

So far, neither the indicating or the recording units has required recalibration or readjustment.

Automatic sampling . . . Samples are taken on one incoming stream by an automatic sampler, see Fig. 4. This sampler is equipped with timers so that samples may be taken (normally) at 5-minute intervals. However, by changing gears, cycles of 30, 15, 10, and 1 minutes may be obtained. It is also equipped with sequence timers so that the time durations for purging the sampler to the sump and taking the sample may be varied. This sampler must be used with a pressure regulator or the sample size will vary with tank head.

Remote-reading averaging thermometers . . . It is planned that averaging resistance thermometers may be installed at Finney in the near future. This instrument consists of an indicating dial and selector switch at the control console and resistance units in the tanks, so that the average oil temperature in any tank can be read.

The installation at the tank consists of a ½-in. flexible brass cable with as many as eight individual resistance wires of different lengths plus a common return wire inside. This hangs in the oil so that for any oil depth, a resistance wire may be selected which

THE AUTHORS

M. J. HAMILTON

C. F. BARNARD

Marvin J. Hamilton, junior engineer with Interstate Oil Pipe Line, joined the company in 1953 after duty with U. S. Air Force. He was graduated from Texas A. & M. with a B.S. in electrical engineering in 1951.

Charles F. Barnard, senior engineer, Interstate Oil Pipe Line Co., joined Interstate in 1946 after World War II. He was graduated from Texas Tech with a B.S. degree in electrical engineering in 1940. Prior to World War II he was employed by General Electric X-Ray Corp.

DEMING TURBINE PUMPS

Perform Dual Service

View at left shows the pumping station, cooling tower and piping system of a midwestern natural gas pumping station.

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Four Deming Turbine Pumps work as a "team" in the installation shown above. Two units deliver 1000 GPM of cold water for cooling an engine and compressor. The other two units pump 1500 GPM each over the cooling tower. (Note the space-saving feature of this installation of four Deming Turbine Pumps, made possible by their vertical construction.)

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is completely submerged, and whose resistance will consequently be a function of the oil temperature at an infinite number of points throughout the wire length. The length of wire selected forms one arm of a bridge circuit in the console unit and produces an output voltage whose magnitude is directly proportional to temperature and which is read at the console directly in degrees Fahrenheit.

On an initial installation, this device could undoubtedly be incorporated into the tank-gaging design so that one position of the selector switch would show both oil height and oil temperature. However, such an arrangement would now require major circuit modifications to our existing tank-gaging equipment as well as to the standard averaging-thermometer unit.

Advantages claimed for the averaging-thermometer system are:

1. Temperature readings can be made in a few seconds, compared with the 20-minute to 2-hour immersion time required for an accurate cup-case-thermometer determination.

2. An accurate indication is given even when a sharp temperature gradient is present. Accurate determination of average temperature by manual cup-thermometer measurement is extremely difficult when a sharp temperature gradient is present because of the changes which occur while the measurements are being made and because the gradient may not be linear.

3. Operational control of such a remote automatic system is much better.

4. The system is not as subject to human error as the cup-case-thermometer method, and is, therefore, advantageous for use in the field where close supervision cannot always be exercised.

Such a system does have disadvantages. It is expensive (about $10,000 for nine tanks) and, though simple electrically, is naturally more complicated than a nonelectric thermometer.

A resistance-type thermometer is presently being used to show the temperature of the oil in the suction line. The indicating dial is on the control console.

Protective Devices

The main pumps, booster pumps, manifold valves and tank agitators at Finney are operated by push buttons located at the control desk. The main pumping units are equipped with solenoid-operated vent valves, suction and discharge pressure mercoids, time-delay relays, and mechanically interlocked switches so that the following start-up sequence is followed automatically when the start button on the station control desk is pushed:

1. The motor-operated pump suction valve begins to open if suction pressure is up.

2. The pump casing is vented to the station sump by a solenoid-operated vent valve.

3. When the pump suction valve is completely open, the motor starts.

4. An auxiliary contact on the main motor breaker starts the motor-operated discharge valve to opening.

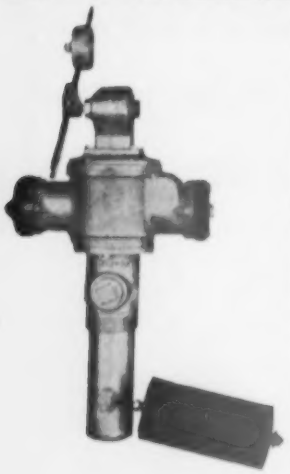
5. When this valve is open, the vent valve closes, completing the starting sequence.

6. If the starting sequence has not been completed, after a period of 2½ minutes, a time delay relay will shut the unit down.

In addition to the above, a number of other points are constantly "sensed" and any deviation from normal will immediately sound an alarm and/or shut down the station. Included are:

1. An instantaneous overcurrent relay which will trip the motor breaker when the motor current becomes extremely large, as would occur in case of major fault currents.

2. A thermal overload relay which is set to have the same rate of temperature rise as the motors. This relay can be



Those endless steps to check tanks are now unnecessary. With an Enardo semi-automatic fill valve, the cocking lever mechanism is also a visual indicator of fluid movement and may be seen from the ground. The lever is easy to cock from the catwalk, just push end of weight lever down and your visual indicator is set. Lever weight up, tank filling; lever weight down, tank full and oil routed to next tank.

Optional equipment on the semi-automatic fill valve is a switch that will shut down the pumping engine, actuate a light on a central control panel, or in night operations, turn on a light at the tanks.

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ENARDO manufacturing company
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set to trip the breakers on a current much less than the starting current or a major fault current if the smaller current is applied for a long enough time to heat the sensing element in the switchgear.

3. In addition to the above, there are five exploring coils in the 1,500-hp. motor windings which respond to increases in temperature. These temperatures can then be read on meters at the switchgear, see Fig. 5. One coil (the one which is normally the hottest) goes to a relay which causes an indicating light on the control desk to come on and an alarm to sound. These are to detect failure of the motor ventilation system.

4. Conventional undervoltage and reverse phase relays provide additional protection to the motors.

5. Each pump has a low-suction-pressure mercury switch. Two station-suction-pressure mercury switches are used, one of which sounds an alarm when the suction pressure drops to a critical value and the other shuts down the station after the pressure drops still further. Excessively high pressure on the outbound line or station discharge line will shut down unit No. 3 only.

6. The motors have bearing-temperature mercury switches set to operate when the bearing temperature becomes excessive due to bearing failure. The motor and pump temperatures and pressure switches are mounted in the homemade cabinet shown in Fig. 6. The cabinet was designed so that it would have enough air circulation because of its "chimney" effect to keep the switches fairly cool. So far, even 107° F. shade temperature have failed to activate the case-temperature mercury switches set to operate at 125° F.

7. The pump cases are likewise protected with heat-sensitive mercury switches, primarily to protect the pump against overheating because of a closed discharge valve.

8. The bearings on the pumps are ball bearing and will not necessarily overheat, even when dangerous wear exists. In an attempt to cover this blind spot in the automatic monitoring program, a vibration relay, Fig. 7, was installed on top of the pump case of each pump. This device has a magnet which holds onto a larger piece of iron known as an "anvil", which is rigidly fastened to the base of the instrument which in turn is welded to the pump case.

When the acceleration of the anvil (or bearing case) exceeds 0.5 gravity, (this setting is adjustable), the magnet cannot follow. It separates from the anvil and the two are held apart by a spring until reset manually. The motion of the magnet, as it separates from the anvil, closes a switch which causes the motor to be shut down. Since only acceleration is involved, the action is affected only by the magnitude of the vibration and not by the frequency.

9. The main pump seals are of the mechanical type. The pump case was drilled so that the seal cooling-oil stream comes from a point near the impeller shaft. It is hoped that by this means the natural centrifuge action of the pump will provide a clean source of oil, relatively free from grit and other impurities.

Any oil that leaks past the mechanical seal is restrained by a packing gland so that it will flow through an orifice to the station sump. The pressure drop across this orifice is sensed by a mercury switch and when it becomes great enough to indicate seal failure, the switch shuts down the pump, sounds the station howler, and causes the appropriate seal-failure indicating lamp to light at the control console.

The seals on the booster pumps are monitored similarly except that their failure sounds an alarm and lights a lamp, but does not shut down the pump.

10. The sump tank and the water

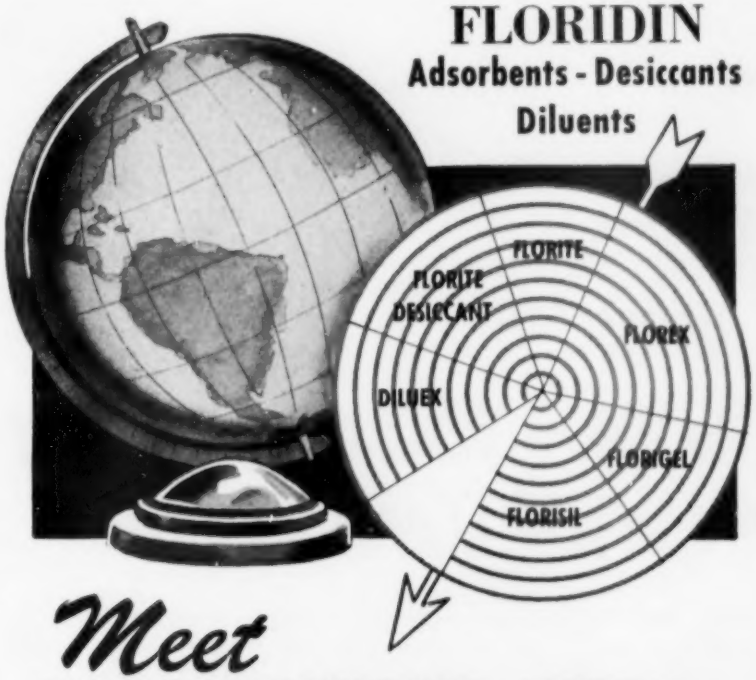

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Fig. 1. *Diesel-driven "Shield-Arc" welders on Linconditioning line. Welders are completely disassembled at start of rebuilding process.*

Fig. 2. *Welders are carefully reassembled on Linconditioning line. Rebuilt welders provide another full service life.*

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levels are controlled by displacement switches. These switches differ from the conventional float switch in that the "float" does not float. There are two solid glazed porcelain "displacers" spaced on a stem, and the whole assembly is suspended in the liquid. It is partially counterbalanced by a spring so that it rises and falls as the liquid level covers and uncovers the displacers.

This arrangement permits the switching actions resulting from the displacement of the upper and lower displacers to occur with a small linear travel of the displacer assembly since there is no motion of the displacers while the liquid level rises or falls between them. This small travel permits another advantageous feature. The connection between the displacer assembly and the switching mechanism is magnetic; therefore, the actual switching can easily be made explosionproof and protected from corrosive liquids. The only parts in contact with the liquid or vapor inside the tank are the glazed porcelain displacers and the stem assembly. No packing glands or seals are required.

11. Another controller, which in this case is of interest because of its absence, is a throttle valve on the outgoing line. Space was provided for a valve if it should prove necessary, but we have found that our start-up electric demand. without the throttle valve, is not appreciably higher than our run demand.

This we attribute to the drooping head-capacity characteristic of a two-stage centrifugal pump. That is, in spite of the very large flow rates resulting from starting against a partially drained line, the head falls off so much that the horsepower demanded, is about the same as the normal demand.

12. Detection of hazardous vapor accumulation is accomplished by a gas analyzer, see Figs. 8 and 9. This instrument pumps through an analyzing head in sequence, a sample of air from each of eight selected points about the station. The operating principle of the analyzing head is this: two filaments are used, one exposed to uncontaminated atmosphere and the other in the flow stream of the sample being tested. The filament in the gas stream will burn hotter than the other because of the combustion of gas.

Where this instrument differs from conventional analyzers is in the means of detection of this increase in temperature; instead of a Wheatstone bridge principle in which the change in resistance is measured (an indirect method since filament resistance is also a function of age as the filament becomes oxidized), the actual change in temperature is detected by a thermocouple bonded to each filament. These thermocouples are wired in series opposition and the difference in temperature corresponding to the per cent of explosive mixture is shown on a pyrometer indicator.

In case the explosive mixture reaches a predetermined per cent, a light will go on indicating the point the sample came from and the station alarm horn will sound.

This instrument has been used at our Bunkie station for about a year. Considerable routine adjustment has been required; it is believed that the use of a more elaborate model with separate analyzer heads should be used wherever the importance of the operation justifies the additional expense.

Miscellaneous

In addition to the above items of automatic measurement and instrumentation, there are other innovations which may be of interest. These include:

1. A hydraulically operated valve on the outgoing 22-in. scraper trap. This is a 22-in. through-conduit valve equipped with a hydraulic operator

How a Sherman Power Digger Does More Work in Less Time with No Standby Equipment

Nearly every department in the city of Hopkins, Minnesota, finds a use for this versatile Sherman Power Digger.

The Water Department uses the machine when cutting off discontinued service lines at the main. They dig a hole in the street (usually blacktop) 3′ wide by 6′ long by 8′ deep. The hole must be plumbwalled for minimum replacement of paving. This operation used to tie up a truck all day, an air compressor half a day, and two men with hand tools, a full day.

Using a Sherman Power Digger, they now do *three* such jobs in one day, with only one man on the digger, no truck, and no compressor, except for concrete pavement. The job goes faster because they can dig the hole, shut off the line, and backfill before the walls begin to cave. Local soil conditions formerly required cribbing many of these excavations.

If *your* work involves the construction or maintenance of underground facilities, you will profit with a Sherman Power Digger. It's compact, fast, and flexible, with low initial cost and amazing economy of operation. Write today for full details, without obligation. Ask for Bulletin No. A16.

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Patent No. 2,303,852
Other patents pending

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Control Section

which opens or closes the valve by using approximately 1½ bbl. of oil (which goes to the sump) for either operation. Since no outside power is required, this type operator should have many applications in remote areas where the convenience of a mechanically operated valve is desired and electricity is not available, see Fig. 10.

2. Nickel-cadmium batteries provide power for opening the switchgear breakers and for emergency lighting in the station building. These batteries were selected because of the extreme mechanical and electrical ruggedness and dependability of this type battery as compared to the lead-acid battery.

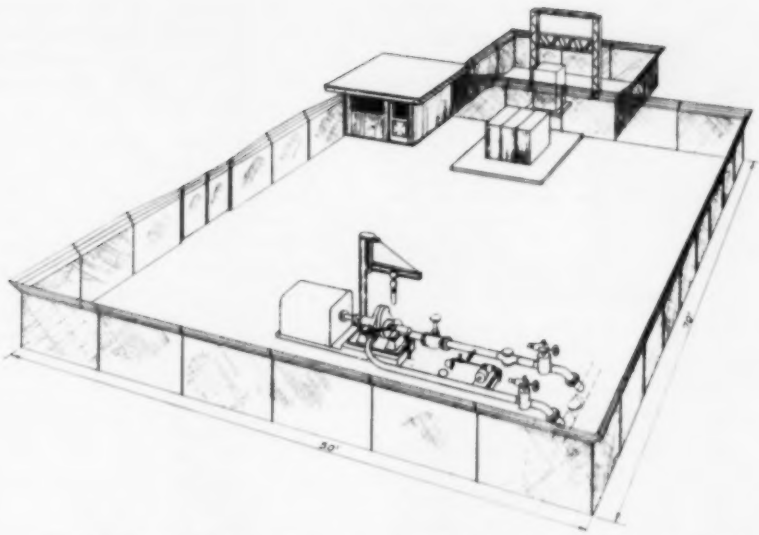
This battery will withstand the ill effects of overcharging, complete discharging, storage, and mechanical abuse much better than will conventional batteries. Though this particular application does not demand all these virtues as a matter of everyday routine, these qualities are in line with the maintenance-free, semiautomatic nature of the rest of the station.

3. Heating or cooling the office building is accomplished by means of a 5-hp., 220-volt, all-electric heat pump, with a 19.5 kw. of resistance heaters. This is necessary for the complete exclusion of oil and gas lines from the station building.

4. Tank agitators are installed in the Finney tanks to avoid the buildup of bottoms and to blend the Talco crude (viscosity 4,000 S.U.s. at 50° F.) with light Arkansas crude (viscosity 40 S.U.s. at 50° F.). The two 80,000-bbl. blending tanks are equipped with two mixers. The other three 80,000-bbl. tanks, the three 120,000-bbl. tanks, and the one 55,000-bbl. tank have only one mixer. The motors are 25-hp., 440 volt, 3-phase, explosionproof motors. The propellers are 26-in. o.d. These mixers can be operated from the control desk or at the tank, see Fig. 2.

5. Lighting of the pumping units, manifold, and tank farm is accomplished by 37 mercury-vapor luminaires. These are 20,000-lumen, 400-watt units mounted 25-ft. 8-in. above the ground. They are turned on at night and off in the morning by a photoelectric relay.

The mercury-vapor lamp has about five times the expected life of a filament-type lamp, but the expected payout of the mercury-vapor lamps will be from their lower electrical consumption because of the higher lighting efficiency of the mercury-vapor lamp as compared to the incandescent. The effectiveness of these lights is shown in Fig. 11.



SIMPLICITY AND SAFETY are basic features of this single-unit automatic station.

What to Consider in Designing Unattended Pipeline Stations

Service Pipe Line's experience suggests these pointers for planning and equipping automatic booster stations.

by P. P. Plovanich

DURING the past few years, more and more pipeline companies have been studying the feasibility of utilizing automatic and remote-control equipment for unattended operation of booster or relay stations. This in no way implies that attended pipeline stations will become a thing of the past, because, until better instruments and meters are field proved and accepted by the industry for custody transfer of oil, personnel will still be required at receiving and delivery points, and at some batching and originating stations.

However, I believe that in the near future, all relay or booster stations operating on "closed or tight-line" systems will be unattended in operation whether automatic or remote controlled. This will be true except for those stations in which management feels that too much is at stake financially and will require an attendant for security reasons only.

First of all, what is the meaning of the term "automatic operation"? Webster's dictionary defines "automatic" as "self - acting or self - regulating." This, then, means that an automatic pumping unit must receive its intelligence to run or not to run from some property of the fluid in the line, such as pressure or flow. In our case we are using pressure as the controlling means.

Basically, this method of automatically controlling a booster unit appears simple; however, batching crudes of widely varying viscosity, or slowdowns at originating stations can create operating requirements at the booster station involving considerable throttling losses through the control valve, whereas if the unit were manually or remotely controlled it could be shutdown until line conditions had changed enough to justify its operation.

Starting and stopping units by varying the hydraulic conditions at the originating station is in one sense remote control. There is no doubt that the use of hydraulic line intelligence from the originating station is the least expensive in initial cost; however, it does have its limitations and some drawbacks. Without telemetering, the operator at the attended stations has no way of knowing the exact operating conditions of the unattended stations, or of the line beyond the unattended station. Hydraulic conditions in terms of pressure and flow at the originating station do not always reflect the undesirable situation in the line or at the downstream station.

For an engineer to sell management on automatic, unattended operation, he must satisfy all concerned that such a station is safe, both as to equipment and personnel, and that the stations will pump oil economically and dependably.

Justifying electric station . . . This paper deals with electrical-centrifugal pumping units. Since power costs for electric units normally run considerably more than diesel or gas fuel for engines, greater savings must be realized in labor and maintenance to offset this higher cost; therefore, the best practices of equipment design and simplicity in station arrangement must be adhered to.

Pump seals are trouble spots in such systems, especially on crude-oil lines where considerable sediment is carried in the oil stream; however, with the use of strainers in the suction lines, (if required), exceptionally good life is being experienced with mechanical seals. In the event of seal failure or excessive leakage, automatic shutdown is effected by draining the seals into a float chamber with a restricted outlet so that an excess flow will actuate a float switch, shutting down the unit.

The major drawback to operating float-switch devices for protection of mechanical seals on outdoor units is the jellying or gumming up of waxes or paraffins in the oil on slow, normal seal leakage. This may stop up normal drain lines, shunting the leakage oil through the float switch causing false shutdowns. In these cases, electric heating of the float switch, drain lines, and mechanical seal chamber should assure better operation.

Also, on outdoor units the mechanical seals should be protected by watertight covers to prevent rain from filling up the float switch, initiating a shutdown. It appears that a pressure-sensing device would be more suitable for detecting seal failure since it would not be plagued with the above difficulties.

A sump tank receives both normal and excess seal leakage. This sump is equipped with an automatic pump for normal operation. However, if the automatic pump should fail or if the drainage into the sump exceeds the capacity of the pump, then a high-level float switch will shut the station down.

Line breaks . . . Another hazard or

This paper was prepared for presentation on September 28, 1954, at the Electrical Conference of the Petroleum Industry, sponsored by the Petroleum Industry Committee and the Tulsa section of the American Institute of Electrical Engineers.

drawback with unattended stations without telemetering, especially on older lines, is the inability to detect line leaks or line breaks. Large leaks or breaks near the station can be interpreted from conventional instruments or meters. However, leaks occurring in the last 10 to 20 per cent of a line between stations are very difficult to detect.

At present we are using a flow comparison or flow differential method to detect line leaks, the principle being: what goes into a line must come out. The difference between the two readings must be leaking into the ground. We are telemetering the incoming flow of one station back to and comparing it with the outgoing flow from the upstream station. Actually, we telemeter the flow from stations where the line terminates in tankage back to the originating station, pumping out of tankage, completely bypassing relay stations.

This method can be very successful on lines that do not run batches. Where batching is being done in the line, some variation shows between the two meters because of gravity differences. This is not a major difficulty, however, and by knowing what grade of oil is being pumped into the line and what is being received into tankage at the terminal point, extremely close checks can be made. Where communications and telemetering facilities are available this method of leak detection is by far the best we know of.

With the rapid development of mass flow meters and velocity-type meters, the differential flow method can be made into an automatic shutdown, detecting very small leaks along any portion of a line without regard to gravity or temperature. This, I feel, will be a great stride towards promoting automatic, unattended operation of older lines, or for that matter, any line where, to meet capacity requirements, it is necessary to operate at maximum pressure limits of the lines.

THE AUTHOR

Paul P. Plovanich has been electrical engineer for Service Pipe Line Co. in Tulsa since 1951. He is in charge of the electrical section which covers design of electrical, communications, and electrical - control equipment. He came to Service Pipe Line after spending about 12 years with Shell Oil Co. in various assignments.

Plovanich is a graduate of West Virginia University with a B.S.E.E. degree. He spent about 4 years in the Signal Corps during World War II and attended Harvard and M.I.T. electronics schools during this period.

Operational Experience

We have in operation two automatic unattended stations operating on local pressure control without any remote telemetering. They each consist of two 400-hp. units and their operation has proved highly satisfactory. We also have an 8-in. system in operation on local pressure controls. This system consists of eight 300-hp. units running from Drumright, Okla., to Joliet, Ill., a distance of 650 miles. It is operating automatically, however, since it is located in an attended station it could not be classed as completely unattended.

Running in parallel to the 8-in. system is a 12-in. system, with 1,250-hp. units, which is also under automatic pressure control at some locations. Results have indicated that the size of a unit is no criterion for automatic operation. Automatic protective equipment operates in the same manner, regardless of size.

The system this article deals with is a series of single 700-hp., automatic, electric-centrifugal pump stations. However, where hydraulic conditions are

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very complex, we feel that remote supervisory control and telemetering can be justified in addition to local automatic controls. The stations can be unattended except for an occasional inspection trip. It is planned that one man can police two such stations.

Electricity can be adapted to nearly all of the needs for power, controls, instrumentation, and heating. The pumps and valves are operated by electric motors. The controls and instruments are actuated by electrical or electronic equipment. Pressures and flow are converted to electrical quantities for control, indications, and telemetering.

Any of the standard supervisory control systems can be used for remote operation. In this proposed system, the remote operator has the option of either operating the station remotely or putting it on local automatic controls. Since our communications are over wire lines and vulnerable to storms, the system is set up so that a failure of the communication equipment or wire line automatically transfers the controls to local automatic controls. This we feel allows us to operate more dependably under safer conditions.

How it works . . . Sequence operation is utilized in both starting and stopping the electric unit, regardless of whether it is by remote or local controls. When a starting operation is initiated the following sequence occurs.

First, the suction valve opens. As the suction valve reaches a predetermined position, a limit switch in the suction valve starts the discharge valve opening. When the discharge valve has traveled about 1 in., just enough to crack the seat and relieve the case pressure, a limit switch in the discharge valve starts the motor. The motor then comes up to speed with the discharge valve continuing to open.

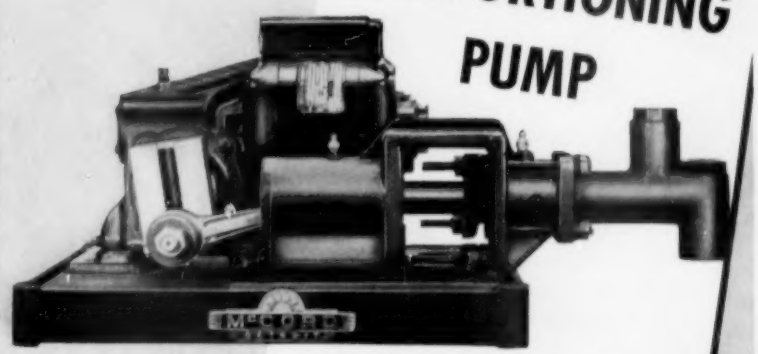
Tests have shown that cracking the discharge valve before starting a unit prevents high buildup of case pressures and also reduces pressure surges in the line. Contrary to standard procedure of starting a unit before opening the discharge valve, this method has given smoother starts without any apparent increase in motor starting time. In addition to a smooth start, this method also eliminates high differential pressures across the discharge valve, thereby reducing torque requirements on the motor-operated valve.

As is well known, running a pump for a prolonged time against a closed discharge valve rapidly builds up oil and rotating-assembly temperatures with a danger of pump seizure. The above method will not allow the unit to start until the discharge valve has broken loose from its seat and is in the process of opening. Should the discharge valve fail to open or the motor fail to start before the suction valve reaches its fully opened position, a relay in the motor starter operates, locking out the motor controls and shutting both suction and discharge valves.

A pressure controller, actuated by both minimum-suction or maximum-discharge line pressures, controls the pneumatic throttle valve on the pump discharge. In addition, where desirable, there may be a third overriding controller actuated from a thermal converter on the motor input. This device actuates the control valve during heavy overloads to prevent establishing a high power demand. This is very important when filling or packing an empty line. During normal operation, this isn't a problem because the line must be packed in order to build up starting pressure. At present, our plans do not include a flow controller.

No frills in design . . . Simplicity in station layout and equipment is of prime importance. The entire station is located in a 50 by 70-ft. fenced area. The substation, the outdoor, metal-clad switchgear, and the small control building

McCORD Class "M" CHEMICAL PROPORTIONING PUMP



Above unit suitable for handling up to 85 GPH. Designed for accurately controlled chemical proportioning service.

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1. Easily accessible suction and discharge valves.
2. New valve design. Highly efficient and easily serviced.
3. New improved type packing, with large stuffing box.
   Reduces necessity of frequent adjustment and does an excellent job of sealing. Available in a range of materials to suit the chemical being handled.
4. Provision for flushed packing.
5. Removable pump unit. Cast iron pump body with stainless plunger standard. All stainless construction available.
6. Positive drive unit. No lost motion.

McCord's half-a-century of experience, covering every phase of engineering development and manufacturing of measuring devices for the lubrication of Diesel, gas and steam engines, and compressors, as well as every type of industrial machinery, provides a background for the class "M" pump.

Special tanks, agitators and meter controlled units designed and available.

Complete engineering data and service available, if you will write us your problems.

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are located at one end of the plot. The outdoor pumping unit is at the other end. The control building and outdoor switchgear are isolated from the pumping units in order to minimize the chances of dangerous vapors getting into the control room and switchgear where the equipment is not explosionproof.

The motor used is of the "weather protected" type. This is a big deviation from the explosionproof, totally enclosed and fan cooled, and forced ventilated motors now commonly used. We admit that there is a slight calculated risk here, however, since these units are located outdoors, we feel the risk is justified.

Winter operation questionable . . . There may be considerable snow in the area where these "weather protected" motors are to operate. The question still remains as to how they will perform during heavy ice or snow storms, blizzards, and drifting snow. There is little doubt that while the units are running, there will be enough heat generated by the motors to melt themselves clear.

If the motor should be idle when the storm hits and it is covered with snow, we may learn something that isn't in the books. We feel the unit will free itself and operate normally; however, if the air passages are blocked and the motor overheats, stator winding temperature detectors will shut the unit down. As protection against the elements these motors are equipped with space heaters and filters, so there shouldn't be any problem from moisture or dirt.

The outdoor metal-clad switchgear contains protective relaying to trip the main breaker in case of single-phase, reverse-phase, and time-delay low voltage, with automatic reclosure when conditions are normal. Tripping on overcurrent will operate a lockout relay requiring local manual reset before reclosure. The motor starter is equipped with a time-delay relay that will trip the main breaker, provided the starter fails to trip whenever its circuit is energized.

Full-voltage starting is used further to simplify design and control. It also helps reduce first cost of equipment.

Extra protection . . . Automatic shutdown of the unit will occur on low suction pressure and high suction pressure. The unit may be restarted automatically or remotely when conditions are restored to normal. In addition, the following functions cause shutdown and lockout requiring local manual reset. All shutdown devices are individually identified by lights at the station concerned:

1. Low instrument air pressure.
2. High line pressure.
3. Low battery voltage.
4. Motor overload current.
5. Locked rotor or prolonged starting current.
6. Motor-winding overtemperature.
7. Hot motor bearings.
8. Hot pump bearings.
9. Hot oil or hot pump case.
10. Pump vibration.
11. Pump-seal leakage.
12. High sump level.

The pump vibration relay is for protection of the centrifugal pump in event of unbalanced impeller, unbalanced or rubbing rotor, loose coupling, and ball-bearing failure.

No ventilation problem . . . The use of outdoor units not only eliminates costly buildings, but also eliminates an enclosure for buildup of hazardous and toxic gases. It also reduces the requirements for expensive explosionproof equipment. Costly ventilating and heating systems are eliminated.

Sequence control of units is simplified because there is no problem of ventilating the motors before starting.

Our experience with automatic pumping stations has passed the trial stage. We feel that stations can be operated safely and economically both automatic and unattended.

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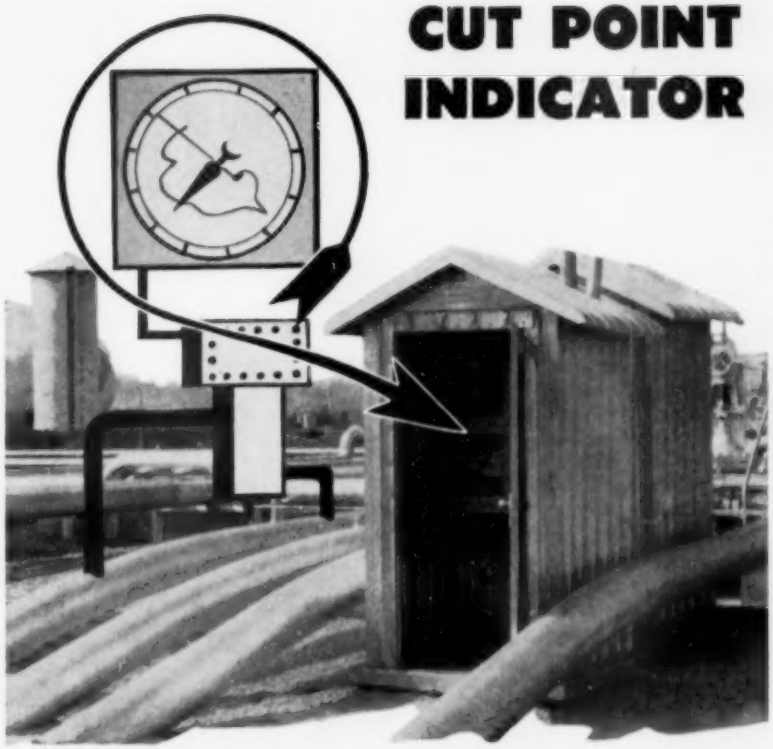

United Engineers announce their appointment as exclusive manufacturing and sales agent for the Carter CUT POINT INDICATOR, as licensed by Standard Oil Development Company. This instrument has been tested, approved and placed in use by a major pipe line company for the determination of the fluid interface between pipe line products and crude.

EXCERPT FROM MIDWEST RESEARCH INSTITUTE REPORT:

. . . "it may be concluded that a capacitance-sensitive device for detecting petroleum product interfaces is the most logical selection of the devices considered. This conclusion is based not only on the results of the measurements and analysis of several physical properties of petroleum products but on the state of the art of instrument design including reliability, complexity and cost. The operation of a capacitance-sensitive unit (Cut Point Indicator) on the — — — — system resulted in detection of 100 per cent of the interfaces in the 60 cases observed."

OTHER OUTSTANDING FEATURES ARE:

1. No working parts in the pipe line.
2. Monitors pipe line continuously and indicates variations in product and crude batches as well as recording length of intermix between batches.
3. This instrument aids the pipe line dispatcher in determining the *exact cutpoint* which will result in the *minimum switching intermix.*

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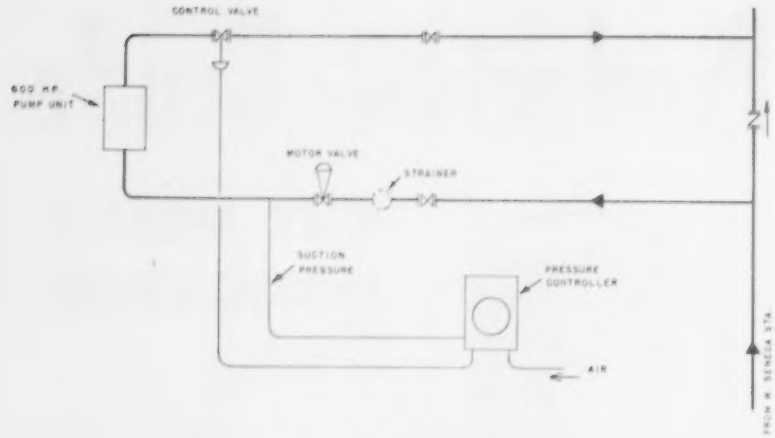
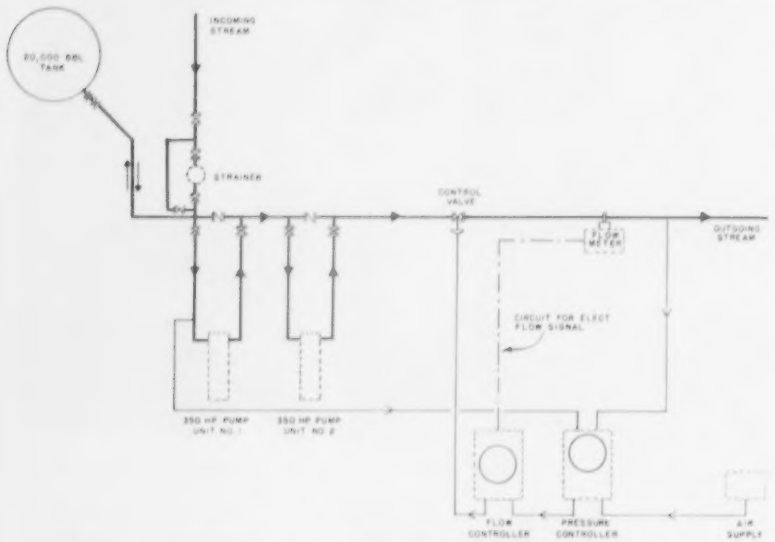


By adding this automatic booster (Fig. 1) at line's hydraulic center . . .



. . . and automatic flow controllers at this main station (Fig. 2) . . .

Ashland Line Capacity Raised From 16,500 to 30,000 Bbl. Daily

by R. F. Delaney and J. E. Brooks

RECENTLY the pipeline engineering department of Ashland Oil & Refining Co. was faced with the problem of increasing the throughput of a 20-mile 6-in. pipeline. The line supplies crude oil to a refinery near Buffalo, belonging to a subsidiary company, Frontier Oil Refining Co. The refinery capacity was in the process of being increased from 15,000 bbl. per day to a maximum throughput of 30,000 bbl. per day.

The existing pump station at West Seneca, N. Y. contained four 6 by 10-in. horizontal duplex reciprocating pumps driven by two 100-hp. and two 75-hp. electric motors, with a maximum throughput of 16,500 bbl. per day at a pressure of 850 psi. This station was manually operated and required an operator to be on duty 24 hours per day. The existing 6-in. pipeline had been subjected to extreme corrosive conditions and up to this time no preventive measures had been taken. Because of the weakened condition of some sections of the line, it was desired to maintin the pressure below 750 psi.

Two possible solutions to the problem of increasing the throughput and still maintaining a safe operating pressure were:

1. Replace a large amount of 6-in. pipe with pipe of larger size and increase the pumping capacity of the existing station.

2. Install a booster station at the hydraulic midpoint of the pipeline, enlarge the existing pump station for increased capacity, and replace only the severely corroded sections of pipe.

In either case it would be necessary to take corrosion-preventive measures.

More capacity needed quickly . . . The refinery at that time was well along with its expansion program and it was necessary quickly to increase the pipeline capacity to be able to supply the volume that would be required by the new plant. In view of the nearing deadline, the slow delivery of line pipe, and anticipated right-of-way difficulties, it was decided to use solution No. 2.

The immediate steps taken were:

1. Replace 2 miles of corroded line through a residential section with coated 12-in. pipe.

2. Build Amherst booster station at the midpoint of line.

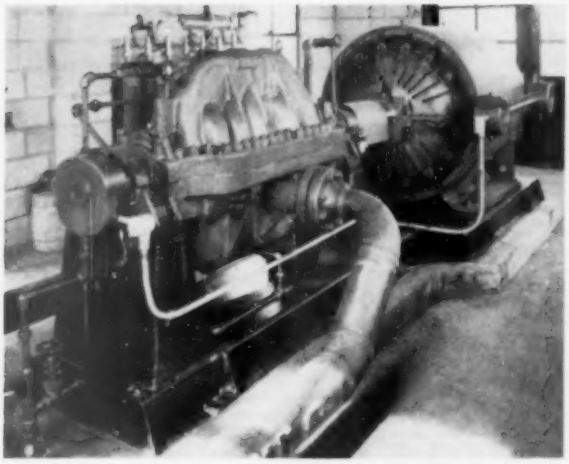
3. Install two temporary diesel pumping units at West Seneca station so the booster station could be placed into operation as soon as it was constructed. Rebuilding the main station was to take longer than building the booster station because a new substation and a more complex manifold was required.

4. Install permanent electrical pumping units at West Seneca station.

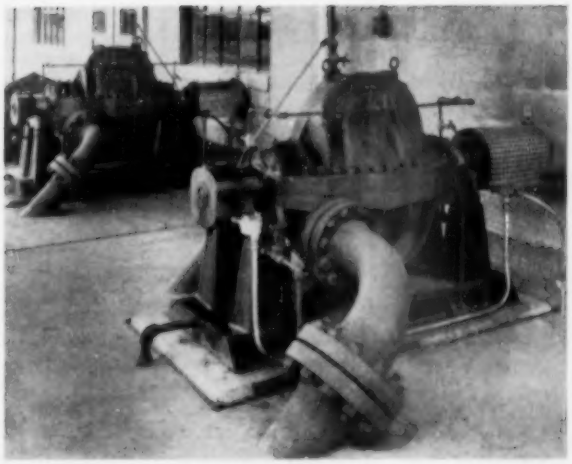
Corrosion problem . . . Because the leak rate on this pipeline had been increasing at an alarming rate, a corrosion survey was made covering the entire line. The purpose of the field investigation was to obtain data suitable to design a corrosion-mitigation system. On the basis of these tests, six rectifier units were installed at approximately equal intervals along the pipeline.

The protection realized from the rectifiers did not meet expectations. A large amount of the rectifier current was lost to foreign structures which required bonding to the pipeline to prevent stray-current damage. Operation of the rectifiers on bare sections of the line may not prove to be economical and this problem is still being worked on.

The Amherst station building is a concrete-block structure having a con-

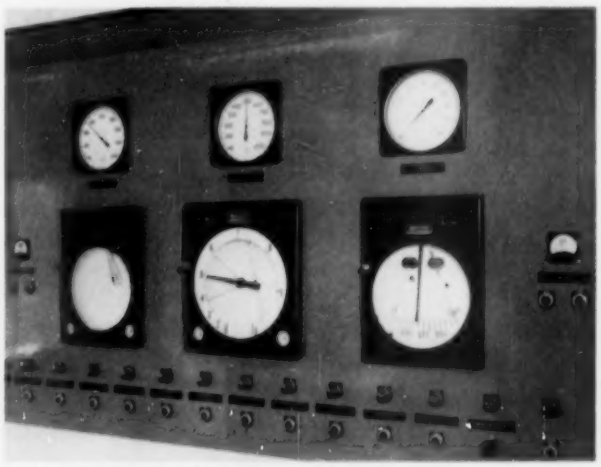


PUMP AND MOTOR installation at the Amherst booster station. The 4-in. by 6-in., six-stage centrifugal pump is driven by a 600-hp. motor.



FOUR-STAGE 4 by 6-in. centrifugal pumps at West Seneca station pump in series at a pressure of 720 psi.

STARTING and metering equipment at Amherst station. The four-step starter prevents serious voltage fluctuation on local power lines.



CONTROL PANEL at West Seneca station. Annunciator lights at base of panel give warning of dangerous conditions.

Control Section

trol room separated from the pump room by a solid wall in order that equipment in the control room need not be explosionproof. The flat roof is built of 4-in.-thick by 1-in. wide prefabricated concrete beams which are covered over with a 2-in. layer of cement grout and a layer of hot-applied roof coating.

Normally the station operates automatically on unattended service. However, provisions are made for manual operation in case some of the automatic devices become defective and must be repaired.

The control room houses the power company's metering cubicle, main circuit breaker, starter, control cabinet, secondary distribution panel, and air compressor.

In the pump room a 600-hp., 3,600-r.p.m., 4,160-volt, explosionproof motor, having a full-load current of 72.5 amp., directly drives a six-stage centrifugal pump designed for 630 g.p.m. at 1,900-ft. head.

On the pump discharge line is an air-operated control valve which is positioned by a pressure controller. After startup and the pump is on the line, this pressure controller, responding to variations in suction pressure, changes air pressure at the control valve to hold it at the correct opening to maintain a constant, predetermined suction pressure. Thus the line is balanced so the booster pumping rate matches the main-line pumping rate. Fig. 1 shows a schematic of this system.

Pressure-operated mercury switches and other protective devices safeguard the station, shutting it down in event of (1) high pump-bearing temperature, (2) high motor-bearing temperature, (3) high discharge pressure, (4) low discharge pressure, (5) high pump-casing pressure, (6) low control-air pressure, (7) fire in the pump room.

In the pump suction line is an electric-motor-operated valve which is closed when the station is down allowing the oil to bypass the station through a check valve in the main line. This check valve is located between the suction and discharge takeoff lines.

Pressure-controlled operation . . . Normal starting procedure for the booster station is as follows:

1. When West Seneca brings sufficient pumping units on the line to start the booster station, the line pressure ahead of the motorized valve increases to a set point, closing the contacts of a starting mercury switch.
2. The motorized, pump-suction valve opens.
3. When the valve is open, a limit

switch makes contact and closes a holding relay in the motor starting circuit, thus starting the pump.

4. A second limit switch, working through a time-delay mechanism, allows the pump to run at full speed against the closed discharge valve for approximately 10 seconds.

5. At the end of this time delay, a switch closes and energizes a solenoid valve which allows air to bypass the pressure controller. This causes the control valve to start opening.

6. When the control valve opens to the point that suction pressure is down to 60 psi., a mercury switch opens to operate another solenoid valve, allowing suction pressure to enter the pressure controller.

7. Simultaneously with step 6, a delay mechanism operates to close the air bypass valve after a 25-second interval. This allows the pressure controller to stabilize to the suction pressure and then take over operation of the control valve. Starting sequence is then complete.

Step starter regulates voltage . . . An unusual feature of this station is the special-built starter. The village in which the station is located is zoned for small business and residential occupancy. The power company had not provided for heavy industrial service. It was expected that heavy motor-starting currents would cause voltage fluctuations on domestic service lines and resultant complaints from residents. Therefore, the power company requested that a reduced-voltage, closed, transition starter be used that would not permit more than 145 amp. per starting step. In this way the power company's substation breakers would not go out and their substation voltage regulators would be given time to balance the line voltage. To comply with this, the manufacturer supplied a large reactor-type starter having four steps. It is interesting to note that on the first step the motor does not actually turn but rather is an initial step to allow the power company's voltage regulators to begin adjustment.

THE AUTHORS

R. F. DELANEY

J. E. BROOKS

Richard F. Delaney, a native of Kentucky, was graduated from University of Kentucky, Lexington, in 1951 with a B.S. degree in electrical engineering. Since that time he has been employed by the pipeline engineering department of Ashland Oil & Refining Co.

Jerrell E. Brooks, an engineer in the Ashland's pipeline department, is a native of Iowa. He received his B.S. degree in electrical engineering from Purdue University in 1949.

West Senaca Station

At the existing pump station, two 4-by-6, four-stage centrifugal pumps directly driven by 350-hp. 2,300-volt induction motors were installed. The manifold is designed for series-pumping operations. One impeller was removed from the No. 2 pump so that line throttling will be at a minimum with the required throughput of 25,000 bbl. per day. This stage will be replaced at a later date when the station throughput is raised to 30,000 bbl. per day.

The crude oil is received at this station from New York Transit Co., and suction is taken directly from its discharge line through a strainer. There is a 20,000-bbl. tank "floating on the line" between the strainer and No. 1 pump suction to supply or absorb any minor differentials between the incoming stream from New York Transit Co. and the station throughput. This

tank also serves as storage to a certain extent.

Flow and pressure control . . . The station throughput is controlled by an air-operated control valve, with a pneumatic flow controller and pneumatic pressure controller connected in series between the air supply and the control valve. Supply air to open the valve enters the pressure controller and is held until the suction pressure is above the minimum set point and the discharge pressure is below the maximum set point. When these conditions are satisfied, air is permitted to pass on to the flow controller.

The air is allowed to pass through the flow controller to open the station control or throttle valve to a position that equalizes station throughput to the amount called for by the index setting on the flow controller. The suction pressure index of the pressure controller is set at the minimum allowable pressure. If the suction pressure falls below this point, indicating that an insufficient amount of oil is being supplied to the pumps, the pressure controller will reduce the air supply. This will allow the throttling valve to partially close, reducing the station throughput to match the input to the pumps.

The discharge-pressure index is set at the maximum-allowable line pressure. If a valve downstream from the station is closed, the pressure controller will start restricting the air supply immediately after the discharge pressure begins to rise. This causes the station control valve to start closing and will reduce the throughput to zero if the valve downstream is closed completely.

The signal indicating actual flow is transmitted electrically to the flow controller from an orifice-type flow meter installed in the station discharge line. The signals indicating suction and discharge pressures are transmitted hydraulically into the pressure controller by small-diameter pipe. The system is diagramed Fig. 2.

Protective devices . . . The station equipment and discharge line are protected by a series of pressure and temperature switches connected electrically through relays to the motor controllers which operate to shut the station down in case any undesirable condition exists. The shutdown equipment protects against any of the following conditions: (1) Low air supply, (2) low discharge pressure, (3) high discharge pressure, (4) high pump-casing pressure, (5) low suction pressure, (6) high pump-bearing temperature, (7) high motor-bearing temperature.

If any of the above-mentioned conditions exist over a predetermined time interval, the station will shut down, a warning horn will blow, and a pilot light on the control panel will be illuminated to indicate the cause of shutdown. The station will remain "locked out" until the source of trouble is eliminated.

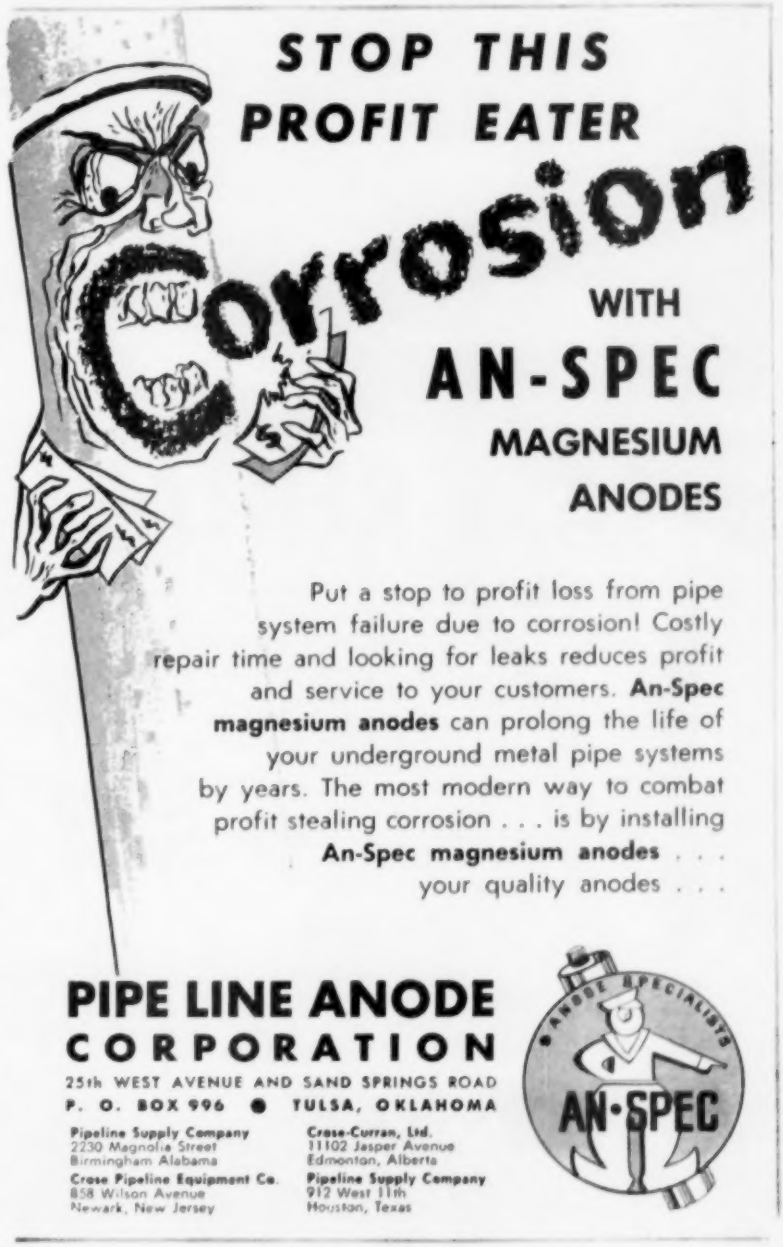
A high-tank-level switch, if actuated, blows a warning horn and illuminates a pilot light to provide protection against overflow of the floating tank. A bell, installed in the operator's home, sounds if any of the above-mentioned conditions exist during his off-duty hours.

System operation . . . This station may pump into the suction of the new booster station or bypass it and pump directly to the refinery, depending upon the amount of crude processed at the refinery the previous day. The amounts of crude received at the refinery each day using different combinations of pumping equipment are as follows:

1. Both 350-hp. units and the 600-hp. booster station will deliver 25,000 bbl. per day at approximately 720 psi.

2. Both 350-hp. units bypassing the booster station will deliver 17,000 bbl per day at 720 psi.

3. One 350-hp. unit and the 600-hp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booster will deliver 20,000 bbl. per day at 520 psi.

4. One 350-hp. unit bypassing the booster station will deliver 14,000 bbl. per day at 540 psi.

At the refinery end of the system, an additional flow meter is installed for protection against loss of oil in case of a line break or excessive leakage. The station operator notifies the refinery of the receiving rate to expect during that day. The index of the refinery flow meter is then set to read a slightly lower rate.

Normally the indicating pointer reads higher than the index setting, but in case of a line break the indicating pointer reads less than the index setting. If this condition exists, a switch in the refinery flow meter closes and transmits a signal back to the station by means of leased telephone circuit.

This signal immediately actuates the warning-horn relay and, if continuous for 5 minutes, the station is shut down by means of a time-delay relay. Because of resulting low suction pressure, the booster station will also shut down. The leased telephone pair also provides a direct-talking circuit between the pipeline pumping station and the refinery.

As a result of these additional installations, the capacity of the line was approximately doubled, the number of operators needed reduced from four to one, and the pipeline leak frequency was decreased.

More Gross Profit With Minimum Investment

(Continued from page 170)

of spark plugs could be extended from 1,100 hours to approximately 22,000 hours of trouble-free service by adopting a plug equipped with platinum electrodes. Though these plugs were more expensive initially, ultimate direct saving in plug cost alone was 22 cents per cylinder per month. Furthermore, indirect saving was approximately six times as great as our direct saving, due to decreased cost of maintenance on magnetos and other accessories. The combined direct and indirect savings amounted to $1.54 per cylinder per month, which in an ordinary six-cylinder engine means a saving of $110.88 per year.

To be even more exact, the ignition expense incurred on a six-cylinder engine equipped with conventional plugs was $124.17 per year, whereas the same engine equipped with the platinum-electrode plugs incurred an ignition expense of $58.38. Secondly, the platinum-type plugs continued to operate "trouble free" 21 months from date of installation and are still in satisfactory service.

Aside from indirect and contingent savings, this test indicates an annual saving of $65.79 per year per engine—repetitive saving that constitutes gross-profit dollars made.

In addition to these direct and indirect savings, we discovered we could also effect other contingent savings. We discovered that an engine equipped with ceramic-insulated, platinum-electrode plugs would continue to operate uninterrupted by even the most drenching rains or snowstorms, whereas an engine equipped with the conventional-type plug was shut down by even a light rain. So we saved more money by eliminating buildings or partial-shelter-type buildings formerly required to protect this type of equipment.

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THE AUTHOR

Alva C. Smith, superintendent of mechanical maintenance of Mid-Continent Pipe Line Co., is in charge of all mechanical installations of the company as well as being responsible for building construction and tank maintenance. Prior to joining Mid-Continent in 1944, he was with Sinclair Pipe Line Co. in various engineering capacities. He has had wide experience in construction of pipelines, stations, terminals, marine docks, etc. Smith was graduated from Oklahoma A. & M. College in 1935 with a B.S. degree in civil engineering. He has also completed correspondence courses in diesel-electric engineering.

in continuous operation almost 6 years, the following facts have been determined:

1. The cost of crankcase lubrication has been reduced 82 per cent compared with standard lubrication practice in pipeline operations. This has brought annual dollar savings of $389.47 per engine per year which represents a direct saving of $1.38 per installed horsepower per year.

2. Each engine has now operated approximately 51,000 hours since installation. All engines are still equipped with the original crankshafts, pistons, and liners, and continue to give reliable and satisfactory service in continuous operation.

3. No crankshafts have required grinding to date and, when recently checked, wear was well within the limits of tolerance.

4. By properly controlling lube-oil and jacket-water temperatures, these original pistons, liners, etc., can be operated approximately 25,000 hours longer before replacements are required.

Nickel-cadmium batteries . . . The simple lead-cell battery commonly used on pipeline pumping engines offers another saving opportunity. Heretofore, it has been common practice to equip each individual engine with a lead-cell battery, but the present trend is toward the nickel-cadmium-type battery with a single battery providing a common source of energy for several units at field gathering stations. These batteries were warranted for a period of 5 years by the manufacturers.

There are numerous installations of the nickel-cadmium-type battery where a single battery has been used to replace as many as three of the 12-volt lead-acid batteries formerly supplied for each individual engine. The results have been highly satisfactory and profitable. From an operation and maintenance standpoint alone, the nickel-cadmium installation is preferable and desirable because it permits the elimination of frequent battery replacements. It also permanently eliminates the use of individual generators, voltage regulators, starter switches, etc., and their constant maintenance demands.

Experience indicates that such a nickel-cadmium installation can be expected to reduce over-all cost by approximately 65 per cent over previous methods of operation. Several of these installations have now been in service from 3 to 6 years and have been practically trouble free. Present observations indicate a much longer service life can be expected.

The development of a lightweight nickel-cadmium battery is now making possible the extension of similar or even greater savings to individual pumping units in widely separated locations. These lightweight 6-volt batteries weigh only 32 lb. and their maximum dimension is 10 in. The manufacturers state that "this type of battery has a life expectancy in excess of 15 years," and their maintenance is simple. On the average, water need be added only once or twice a year.

Naturally, the long life of this particular model has not been fully confirmed in field service due to its unusually long life expectancy; however, the nickel-cadmium principle is proved

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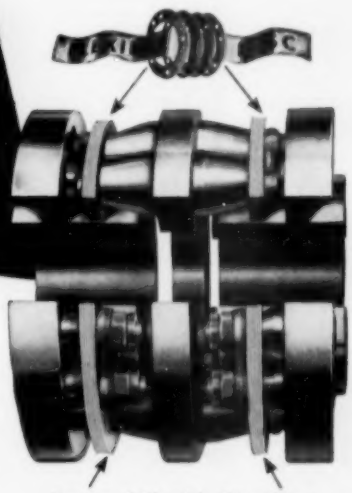

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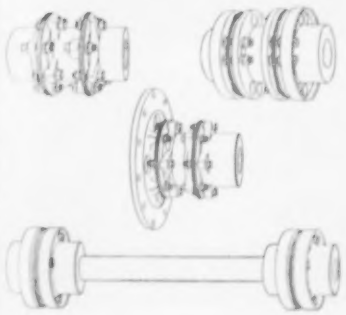
NO BACKLASH	No Loose Parts. All Parts Solidly Bolted.
CAN NOT "CREATE" THRUST	Free End Float under Load and Misalignment. No Rubbing Action to cause Axial Movement.
PERMANENT TORSIONAL CHARACTERISTICS	Drives Like a Solid Coupling. Elastic Constant Does Not Change. Original Balance is Maintained.



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for practical field use as described above. Several of these lightweight nickel-cadmium batteries are now being tested on various field applications, and the results to date have been very favorable.

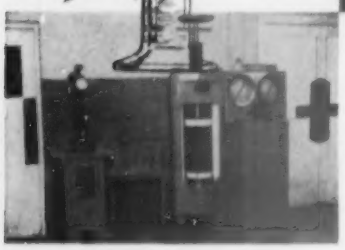
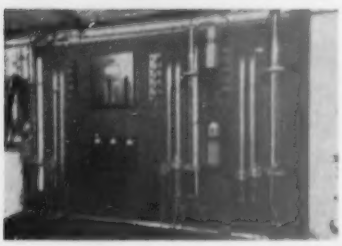
There is little doubt the lightweight nickel-cadmium-type batteries can now be mounted on a field gager's truck to serve as the common battery for each and every engine in his particular district. Receptacles and a "plug-in" type of push-button solenoid switch serve to connect the battery on the gager's truck to the individual pumping units.

This method of operation will likewise eliminate the same replacements and maintenance requirements above described. If these batteries perform satisfactorily for the 15-year life expectancy, or even half of this life expectancy, a reduction in over-all cost of more than 65 per cent can be expected. The potential yield in gross-profit dollars from these applications is presumably obvious.

Other opportunities . . . There are many more specific examples similar to those described above which can and are now being used to eliminate expense dollars. In almost every instance, these examples involve a seemingly unimportant item and commonly known fundamentals that have not generally been applied.

The following items are potential sources of increased gross-profit dollars:

1. Pumping-equipment applications—a potential source of direct and indirect savings.
2. Power applications—probably the highest-potential source of direct savings—local conditions are one of the most important primary factors.
3. Close coordination between maintenance and engineering design and layout — probably the highest-potential source of reducing high ultimate cost or misapplication.
4. Closer coordination between purchasing and operations or maintenance—another means of eliminating and forestalling high ultimate costs.
5. Mechanization and power tools—an immediate source of reduced over-all costs.
6. Maintenance and servicing of seemingly unimportant items such as pump valves, liners, pistons, crankshafts, and many other similar items requiring frequent repairs or replacements. This is a source of most profitable and surprising rewards and the dividends are high.
7. Built-in handling facilities such as overhead-trolley ways, jib cranes, electric or differential hoisting equipment, and access platforms. All these make the work easier while reducing cost and manpower requirements.
8. Chemical cleaning equipment.
9. Good transportation equipment adequately equipped for servicing and maintenance.
10. An effective safety program and approved safety equipment — probably another high-potential source of direct and indirect savings and an absolute requirement in maintaining employe morale.
11. Greater emphasis on public relations from the standpoint of each and every individual employe.

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High-Pressure Air Testing and Cleaning

(Continued from page 186)

2 and 4-in. manifold piping and the 4-in. suction and discharge lines were held together in convenient lengths for transporting with Unibolt couplings.

In order to take full advantage of the pressure which would be left in a tested section, a suction line was tied into the upstream 8-in. riser on the gate valve assembly, while a discharge line was connected to the downstream riser. A Petco air scrubber was incorporated into

the design on the downstream side of the 4-in. discharge line (see Fig. 3). Its purpose was to separate water from the air during compression as well as any lubricating oil which might leak into the discharge line. Typical results in the use of the air scrubber are shown in Table 2.

As a precautionary measure during the cleaning and testing operation, high-pressure samples of compressed air in the pipeline were extracted periodically and turned over to accredited laboratories for inspection as to the hydrocarbon content. This practice was followed to insure the effectiveness of the scrubber in preventing the entrance of compressor-cylinder lubricating oil into the pipeline. In every test no trace of hydrocarbon was found.

Control of Station

The entire portable compressor station was controlled by employing a central panel board of pressure gages and by a series of temperature gages and thermometers strategically located throughout the installation. The panel board was situated in a shelter house erected a few yards from the compressor units. It consisted of three gages giving the pressure at each of the 4-in. headers in the manifold. Inasmuch as all three of these pressure lines manifolded into a common header it was possible to deadweight any of the three at any time to effect the desired control throughout the station.

Control of the suction and discharge pressures at the main line was handled in a similar manner by the use of gages and deadweight control which were tied into the main line with ½-in. pipe.

With the portable compressor station installed at a base location, there was no delay in commencing the cleaning and testing. This operation was geared to cover a main line section of approximately 12 miles, sandwiched between gate valves which were installed simultaneously with the cleaning and testing operation. (In actuality the length of these sections varied as much as 3 miles.) It was necessary that the construction crew complete lowering in the pipe at least two sections in advance of the portable compressor station before testing could be started.

Testing Procedure

From the base location, the testing of the two adjoining sections required the most time inasmuch as a large percentage of the air had to be brought in from the atmosphere. Referring again to gate setting No. 812 (Fig. 1, Part A), the first step was to build up pressure in section B to approximately 650 psi. Then a portion of this air was used to clean section A and the two sections were equalized. The next step was to build the pressure in section A to approximately 650 psi., at which time section B was cleaned. Pressure in section A was then increased to 1,050 psi. (high-pressure test level), after which it was equalized into section B. Afterwards, a portion of this air was used to clean section C and section B was then pressured to 1,050 psi.

After the first two 12-mile sections had been tested, the procedure followed a set pattern. With a test pressure of 1,050 psi. in the last tested section, approximately 200 psi. of air pressure was bled into the adjacent downstream section. This 12-mile section was then deadweighted and the right-of-way carefully walked to insure against leaks. (In the meantime the compressor units continued to pump into the tested section, where the pressure had been reduced to 850 psi., thus avoiding the loss of pumping time.) As soon as the new section had been examined on foot, the pressure between the two sections was equalized.

At this point the six PO-400's were

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". . . it would appear that there are no limitations to the use of air for cleaning and testing purposes."

disengaged from the base station and transported downstream to the gate valve (setting No. 813), while the three PO-8's were left at the base station to continue pumping. Approximately 8 hours was required to move the smaller units to the new site and to manifold them back into the line. (See Fig. 1, Part B, and Fig. 4.)

After equalization there was a pressure of approximately 525 psi. in sections B and C and the portable compressor units were situated between the two sections. The three PO-400's (11½ by 5½-in.) were then used to take suction from the upstream, or tested, section for pressuring the new section. When the suction pressure dropped below 475 psi., the PO-400's (3¼ by 5½-in.) were placed in series with the high-pressure units to give added capacity. It was found that the suction pressure could be dissipated to about 100 psi., at which point it was necessary to have the capacity accelerated by building up from atmosphere with the three PO-8's left at the base station. During the testing of a complete division of the main line, the three PO-8 compresor units were left pumping at the base station in order to maintain a pressure as close to 150 psi. as possible in all the tested sections.

Cleaning Phase

At a convenient point between pressures of 600 to 800 psi. in the tested section, the next section of the line was cleaned. This operation involved the use of a pig launcher, Fig. 5, and a check joint, Fig. 6.

The launcher consisted of an 18-ft. 8-in. section of 31 by ⅜-in. pipe used as a loading barrel. This size pipe was selected to facilitate loading 30-in. cleaners and squeegees. It was enclosed on the upstream end with a Yale blanking cap, while at the downstream end it was welded to a 15° reverse bend that could be tied into the main line with a 30-in. Dresser coupling. This barrel was securely braced above a section of 30-in. pipe, which in turn could be connected to the air supply in the main line by use of a second Dresser coupling. Four-inch piping equipped with valves joined the launching barrel with the lower section of 30-in. pipe.

Once the cleaners were placed in the launcher, they could be released by opening the 4-in. valve and allowing air pressure to start them through the main line. A 30-in. cap with an 8-in. pipe and valve protruding from the center of the launcher connected it with the downstream 15° bend. The purpose of this pipe and valve was to pass air at the required velocity for blowing the line.

The launcher was designed to release two pig cleaners and one squeegee, or one pig cleaner and three squeegees in sucession at predetermined time intervals without shutting down the pressure. The main purpose of this special launcher was to conserve air pressure and impressive results were achieved in this direction. (See Table 3 for pressure data in cleaning a typical 12-mile section of 30-in. pipe.)

It was found that an average section of pipe could be cleaned with the use of approximately 2,400,000 cu. ft. of air; a dirty section required 3,000,000 cu. ft. of air; while a wet section necessitated 6,000,000 cu. ft. of air. An intense campaign was conducted by the two main-line contractors to keep the pipe free from dirt and water. This effort materially reduced air requirements and expenses.

High-Pressure Test

Once the line had been cleaned, the final step was to conduct a high-pressure test between 1,000 and 1,050 psi. Maximum operating pressures will not exceed 935 psig. at any point on the main line.

The test consisted of positioning deadweights at the gate valve location on either end of the section under test, see Fig. 6. These positions were in continuous contact by radio with the base location. The deadweight pressures were kept under constant surveillance during the entire test period and frequent readings were radioed to the test control point. Flagmen were located at all highway and railroad crossings along the section as an additional safety factor, even though these crossings had been hydrostatically tested.

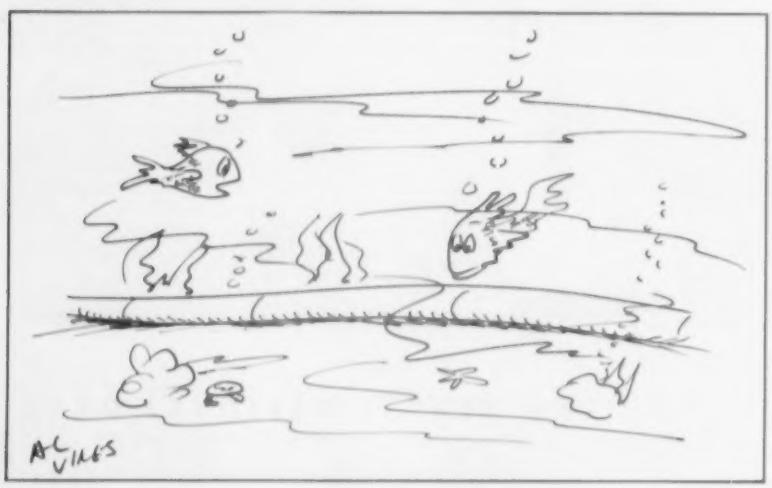
After a pressure of 1,050 psi. had been reached and no leaks reported, the entire cycle of cleaning and testing could be repeated on the next adjacent section of main line.

Once the cleaning and testing operation had been concluded on a section of the line, it was found desirable to retain an air pressure of nearly 150 psi. in the line in order to keep the system dry throughout. Subsequently the air was cleared from the line as the system was made ready for operation.

Conclusion

From the experience gained by Gulf Interstate in the construction of its new pipeline system it would appear that there are no limitations to the use of air for cleaning and testing purposes. This high-pressure air method proved completely satisfactory in every respect. There was never any doubt as to the efficiency of the air test. Undoubtedly the greatest benefit derived by Gulf Interstate through the use of air was a savings of time. The company was able to complete the cleaning and testing operation within a matter of days after the pipe was laid out, permitting it to have the line ready for service far quicker than if conventional methods had been used.

In addition, by using air Gulf Interstate was able to eliminate the considerable expenditures ordinarily required for the large volume of gas necessary for cleaning and testing purposes.



"It's a long, long monster . . . came in one day and hasn't moved since."

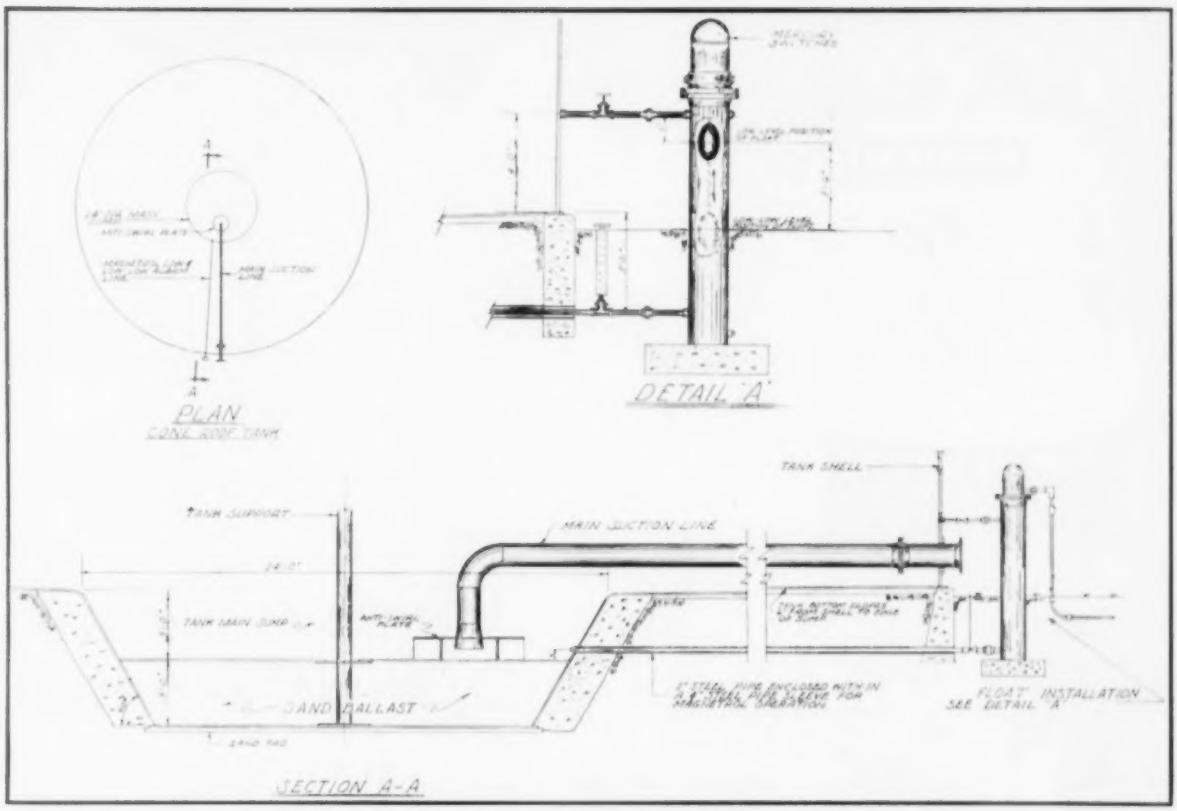


Fig. 1—Details of low-level-alarm installation on product tank with deep sump.

Level-Alarm Controls Aid In Stripping of Tanks

This control circuit offers a method of completely stripping a tank without danger of losing suction. The method has been used successively for 8 years by Plantation

by H. L. Daniels

AT tank-farm pumping stations where sumps are installed in the tanks to allow the production to be completely evacuated and it is not possible to gravitate the product, then a booster pump must be installed at each tank to furnish station suction pressure.

If a horizontal-type centrifugal pump is utilized, and installed at tank-bottom level, then protective devices must be installed to prevent starting the pump when the liquid level in the tank is below the top of the pump and to prevent the pump from running dry when the product is evacuated.

Fig. 1 shows a tank-bottom sump with combination fill-and-suction line and floats in an enclosure to trip mercury switches when definite liquid levels in the tank are reached. The mercury switches are in the closed position when the liquid level in the tank is above the floats, and the circuit is energized only when this tank is furnishing product for station suction. The top float opens the mercury switch when the liquid level in the tank reaches 3 ft. 6 in., which is the top of the booster pump. The bottom float opens the second mercury switch when the liquid level in the tank reaches the top of the tank sump.

Electrical circuit . . . Fig. 2 shows the control circuit in the motor starter for the individual booster-pump motor at each tank location. Relays E-1, E-2, and E-3 are associated with the level alarm controls.

Relay E-1 is a normally open circuit and is actuated by a maintained stop push button located at the motor. The motor can be stopped in an emergency at the motor location and the push button is actuated for safety when mechanics are working on the unit. If the motor is stopped while operating, the alarm is sounded and a white indicating light is energized on the individual-unit starting panel.

Relay E-2 is in a normally closed circuit. When the liquid level in the tank reaches 3 ft. 6 in., the mercury switch is opened by the action of the upper ball float. This sounds the alarm at the pumping station, lights an amber indicating light on the individual-unit

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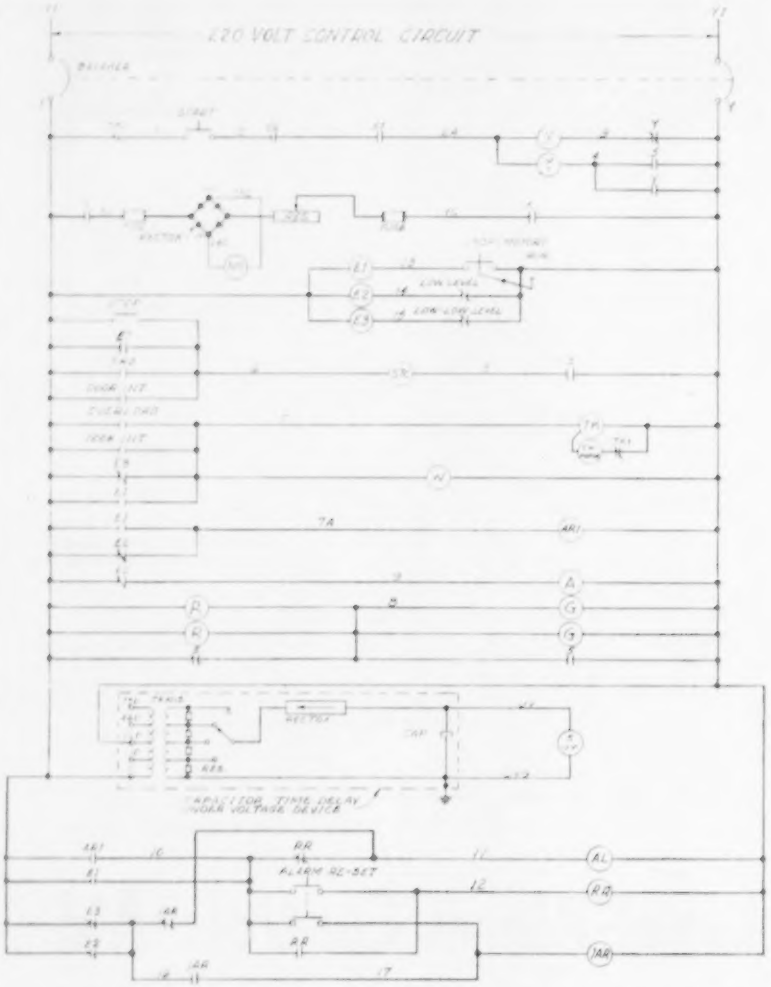


Fig. 2—Circuit diagram of motor starter showing how low-level switches control motor.

starting panel, and opens the starting circuit in the motor starter.

The alarm is silenced by the reset button, but the amber light continues to burn as long as the control circuit to this motor is energized. Accidental tripping of the booster pump motor or a power failure are the only reasons for attempting to restart the motor when the liquid level in the tank is below 3 ft. 6 in.

Low-low alarm . . . Relay E-3 is also in a normally closed circuit. When the liquid level in the tank lowers to the top of the sump, the mercury switch is opened by the action of the lower ball float. This again sounds the alarm at the pumping station, lights a white indicating light on the individual-unit starting panel, and energizes a timing relay in the motor starter.

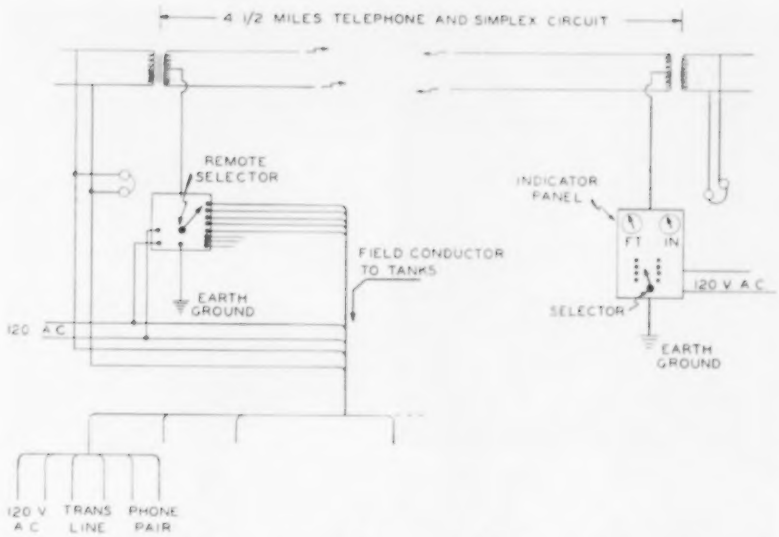
The alarm is silenced with the reset button, and the timing relay is set to trip the motor when the sump is empty. For a rate of 4,000 bbl. per hour, this is 1½ minutes, which gives the station operator sufficient time to switch the suction stream to a full tank without interrupting the pressures at the pumping station.

This installation has been in operation for 8 years with excellent results.

Control Section

THE AUTHOR

Horace L. Daniels has been chief inspector for Plantation Pipe Line Co., Atlanta, since 1951. He began work with the company in 1947. He served with the cavalry in the U.S. Army and was discharged as captain in 1942. Following World War II, Daniels was with the Department of Communications at Fort Riley, Kansas, as instructor and with the Walker Electrical Co., Atlanta, as a draftsman.



PULSE-TYPE remote tank-gage system operating over a simplexed communication system. Fig. 1.

Here's the way Texas-Empire achieves

Remote Tank Gaging Via 4½-Mile Wire Line

by R. G. Deering
Assistant Pipeline Editor

REMOTE tank gaging of eight 80,000-bbl. capacity crude-oil storage tanks over a 4½-mile simplex wire circuit is now being done by Texas-Empire Pipe Line Co. The remote gage system was installed early this year and enables the Texas-Empire dispatcher, located in the Philtower Building in downtown Tulsa, to gage quickly and accurately any one of eight tanks owned by The Texas Co. and located at the latter's West Tulsa refinery.

The system sends and receives level intelligence in the form of d.c. current pulses over a conventional two-wire telephone circuit without interfering with voice transmission on the circuit. In operation the electrical system automatically identifies the tank that is connected into the transmission line, thus insuring against erroneous tank selections.

Installation of this system brought about a considerable reduction in expenses connected with gaging operations at the West Tulsa farm and made dispatching much more efficient. The dispatcher now has at his fingertips means of obtaining direct readings of the oil level of each connected tank and, if required, can gage the eight tanks in the time that he previously would have spent in waiting for a report on one tank.

General description . . . The electrical portion of the system consists of a level indicator and a director, mounted in the same cabinet and located at the dispatcher's desk, a simplex communication circuit connected with the tank farm, a field selector panel at the farm, conductors to each tank from the field selector, and electrical level transmitters at each tank. Fig. 1 is a schematic diagram of the system.

The principle of operation of the system is much like that of any dial telephone network in that a series of d.c. pulses from the director serve to close relays and advance stepping switches at the remote selector to connect one particular tank to the level-indicating dials. When this connection is made the tank transmitter sends back to the indicator a number of pulses corresponding to the number of the tank being gaged, another series of pulses corresponding to the integral number of feet of oil in the tank, and a third series indicating the inches and eighths of inches of oil above an integral foot mark. Results of these pulses appear, respectively, as a red light on the selector switch panel opposite the number of the tank that is connected, and as feet-and-inch readings on dials mounted in the indicator panel.

Transmission line . . . An existing telephone line was utilized for connecting the office and remote instruments for this gage system. It was modified for this service by placing of center-tapped, 1 to 1 isolating transformers at both ends of the line. The tank-gage equipment was then connected between the center tap of the transformers and a suitable ground, forming a simplex channel with the voice circuit. See Fig. 1.

Telephone connections are made to the primary side of these transformers and the transmission line is connected to the secondary. Pulses introduced at the secondary center taps of either the receiving or transmitting end of the line will divide equally in the transformer and two-wire line and will induce no voltages in the primary or voice side of the circuit. Thus, voice communication and gaging intelligence can be carried over the circuit with no interference between them.

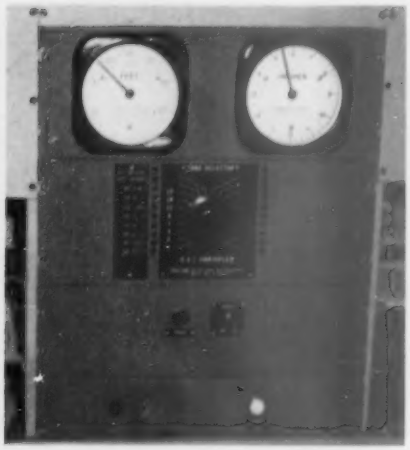
Tank selection . . . The tank to be gaged is selected by moving a rotary switch (see Fig. 2) mounted on the face of the director panel, to the proper tank number. An "operate" switch is then closed and the following events occur in sequence.

1. A stepping switch within the director unit rotates and, in doing so, sends a series of 48-volt d.c. pulses over the transmission line; the number of pulses sent determine the tank that will be connected for gaging.

2. A stepping switch at the remote tank selector advances in response to the pulses and connects the specified tank transmitter to the line. This connection is held by a motor-driven timing cam for a period sufficient to complete the gaging cycle on any selected tank.

3. The director then sends a "start" pulse which causes a relay in the transmitter to pull up. Action of the relay grounds the simplex line through the transmitter and at the same time energizes a small, shaded-pole, 110-volt a.c. motor which drives a cam switch in series with the line. This switch opens and closes a preset number of times, sending a confirming or identifying series of pulses back to the director.

4. Receipt of the pulses at the director causes an indicator bulb to light



INDICATOR PANEL at the dispatcher's desk has a row of lights to the left of the tank selector switch to identify the tank being gaged. Fig. 2.

WEATHERPROOF junction boxes are the terminating point of conduit runs for field wiring. The runs were laid along tank firewalls. Fig. 3.

GAGES with their electrical connections were installed on the tanks in this manner. Brackets were not welded on due to safety regulations. Fig. 4.

Control Section

opposite the number of the tank that has been connected. Since each tank transmitter sends a different number of pulses, the dispatcher can tell at once if the proper tank is in the circuit.

5. The transmitter then sends a series of pulses indicating the integral number of feet of oil in the tank. The pulses are generated by the motor-driven cam switch and the number transmitted is governed by the angular displacement of a cutoff contact. This contact is mounted on a disk driven by the float mechanism and its displacement from a zero position is a direct function of the oil level.

A wiper arm, mounted in the same plane and rotating about the same center as the disk, has an initial position corresponding to the zero position of the contact, i.e., the two would be touching if there were less than a foot of oil in the tank. It is also driven by the cam-switch motor and starts rotating toward the cutoff contact when the foot pulses are initiated. Touching of the cutoff contact by the wiper arm causes a relay to open the transmission line and stop the foot pulses. Since the time interval involved in rotating the arm to the contact is a function of oil level, the pulses generated are a direct indication of this level.

Lock-stop arrangements are used to prevent transmission of pulses other than those corresponding to whole feet.

6. In a like manner a series of pulses are then set to indicate the inches and eighths of inches of oil above a whole foot mark.

7. Both foot and inch pulses are transmitted directly to disk on the indicator panel at the dispatcher's desk. Pointers on these disks are geared to stepping magnets which are actuated by the transmitted pulses.

8. With the completion of the inch-pulse transmission all equipment is automatically disconnected and returned to a standby position for the next gaging operation. The pointers, however, hold the last reading until cleared by pushing of the reset switch or until initiation of the next gage operation.

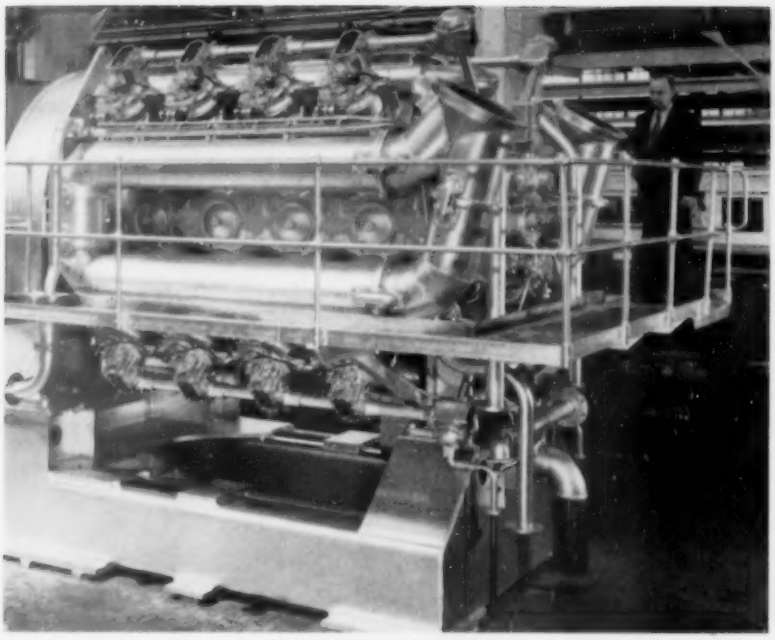
Field wiring . . . It is required that each transmitter have 120-volt a.c. power, a separate conductor for pulse transmission, and a solid ground. In this case a metallic ground was carried to all tanks, with the contact to earth being made at the remote selector panel. In addition to conductors for power and pulse transmission, two conductors were carried to each tank for use as telephone pairs. These were bridged across the telephone line on the primary side of the isolating transformers and allow field personnel to converse with the dispatcher while performing routine maintenance or while calibrating a gage. The telephone pairs are terminated in explosionproof fittings at each tank transmitter.

Individually insulated conductors of No. 14 wire covered with type TW insulation were used in this installation in place of the more conventional but much more expensive multiple-conductor control cable. All conductors were installed in conduit which was buried to an average depth of 24 in. Main conduit runs were buried along the tank firewalls and conductor terminations were made on the firewalls in weatherproof junction boxes as shown in Fig. 3. Use of explosionproof junction boxes was thus eliminated since the boxes are in an area classed as non-hazardous. Conductor runs to individual tanks from the junction boxes were also placed in conduit and were terminated in explosionproof fittings at the transmitters.

Operational history . . . As is common throughout the pipeline industry, the gages are now being used for hourly gages on working tanks and for stock gages but are not used for custody transfer. The installation, however, has made it possible to reduce the gager personnel at the farm, with two men being transferred to gaging positions at other localities. The remote gage system and a rearrangement of pumping orders so that all tank switches could be made during the day shift make possible the present operation of the farm with only one gaging shift per day.

Since its installation the system has performed very satisfactorily with a minimum of maintenance. Relays, stepping switches, and other electrical components have given no trouble; the only difficulties encountered so far, and these have been few, have been of a mechanical nature, i.e., excess friction and resulting loss of calibration. This trouble stems from the fact that it has not been possible to securely attach the gages to the tanks because of a policy prohibiting welding on tanks containing oil. See Fig. 4. It is anticipated that as soon as it is possible to affix each gage permanently in position the entire system will function in a trouble-free manner.

The remote gage system was engineered and installed by the communication department of Texas-Empire Pipe Line Co. under the direction of Murl F. Hill, assistant to the superintendent of communications.



Built on a horizontal plane, this engine can be direct connected to standard speed increasers or reduction gears, to drive centrifugal compressors or liquid-products pumps for pipeline installations.

General Motors develops

New X-Type Engine for Pipelines

by Eric R. Brater

A NEW X-type natural-gas engine has recently been made available for pipeline applications. The 16-cylinder, spark-ignited engine is loop scavenged, and while the nominal rating is 3,300 hp., it has been operated at 3,500-hp. output. It was developed by Cleveland Diesel Engine Division of General Motors Corp. In 2 years of industrial power-plant service, the engine has proved able to carry rated loads continuously and to require a minimum of maintenance.

The new horizontal engine, Model 358, is being built with engine-driven scavenging compressor and attached engine accessories. It can be direct-connected to standard speed increasers or reduction gears and will drive either petroleum pumps or centrifugal compressors.

With the application of this engine for pipeline installation in mind, the engine in combination with speed increaser and centrifugal compressor would be a high-powered, compact, and rugged unit.

Furthermore, because of the compact design of the engine, as well as the direct-driven attached accessories, not only would much pump-station piping be eliminated but also crane requirements, building size, and building costs would all be materially reduced.

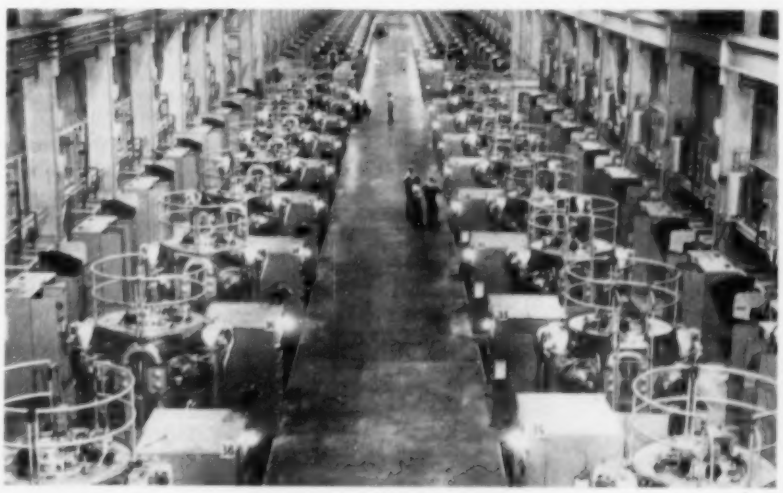
Power-plant service . . . For the past 2 years 41 of the GM Model 358 vertical engines have operated at the Reynolds Metal Co. plant near Corpus Christi, Tex., for 95 per cent of the total available hours. Also during this 2-year period, they have operated at a high load factor, producing 90 per cent of the total power available from the installed generating capacity. The generators which the engines drive produce power for the aluminum-reducing pots of the plant. This total power is based on 41 engines running continuously.

In looking at this 90 per cent factor, first, it is not possible to maintain a continuous load on each engine, due to operational requirements of the aluminum pot line. Secondly, it is not possible to operate all 41 engines continuously for normal maintenance of the engine, generator, and auxiliary equipment.

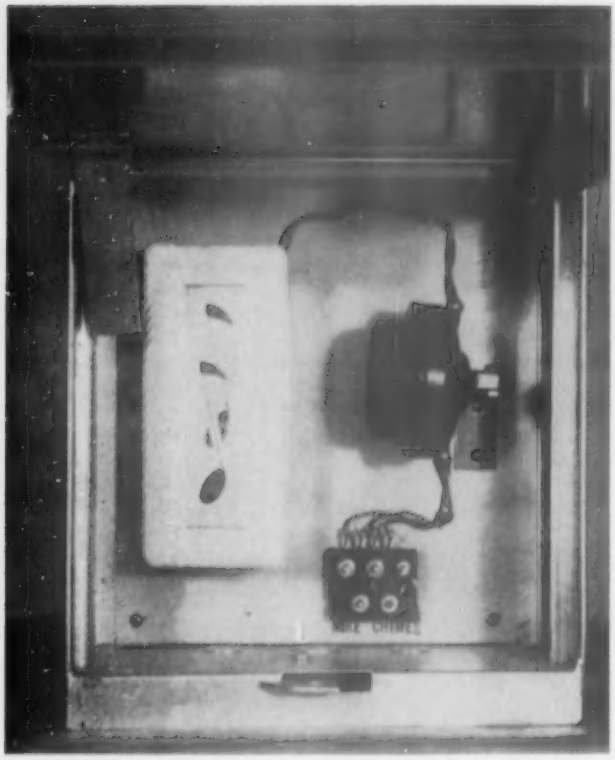
During this same 2-year period, the average load per engine was maintained at 95 per cent of its total generator kilowatt capacity, as demanded by the pot lines. Moreover, fewer than 5 per cent of the total operational hours during this 2-year period were used for maintenance. These statistics concern a new product in a new operation. In this period were encountered all the problems which are always associated with a new installation. These results will be improved as the operation of this plant progresses.

The Cleveland Diesel Engine Division of General Motors is now undertaking to serve the petroleum and pipeline industries from a background of manufacturing for marine and utility applications.

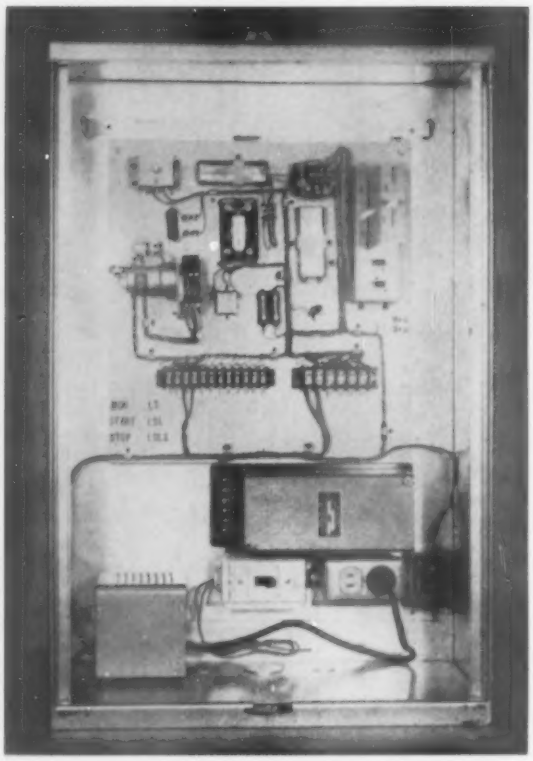
Author is assistant chief engineer, Cleveland Diesel Engine Division, General Motors Corp.



A view of the Reynolds Metals power plant showing the 41 engines. The control cabinets are located on the inside of the aisle.



Conventional telephone mouthpiece used as microphone at controlled station. Small chime signals that power is available at motor. The unit is usually mounted on pump case.



Control equipment for unmanned station is mounted at station site. No other devices are required yet dispatcher has start, stop, and monitor supervision over station.

Controlling Unattended Gathering Stations

A simple, telephone-type code system coupled with a conventional microphone enable Sinclair's dispatcher to start, listen to, and stop pump units at many of the company's unmanned field gathering stations.

by S. M. Hammer

MORE than 25 years ago a device for controlling (and receiving operational information from) a pump station was demonstrated at one of the International Petroleum Expositions in Tulsa. This device employed a code selector mechanism, activated by pulses from the control point, which caused selected functions to take place at the pump station. Codes were also transmitted which would cause operational information to be sent back to the control point. Lights and alarm signals indicated the operating status of the pump unit.

Sinclair Pipe Line Co. is today using a modified, vastly improved version of this basic supervisory system to facilitate its dispatching operations. This method affords complete and centralized control over a great number of field gathering stations which pump into the main lines.

With the advent of high-capacity pumping facilities, these nonmanual methods of control have become a necessity. A pump station can be automatically controlled and operated by means of hydraulic and pressure indicating devices, to control such functions as the opening and closing of large valves, the starting and stopping of pump units, etc. A pump station's valves can be designed to operate in this manner, controlled by upstream and downstream hydraulic variations. The station also can be controlled easily in a sequential manner by manually operating a few push buttons on a control panel near the pump unit.

Because of the large volume of crude petroleum handled by a modern pipeline system, it is highly desirable to maintain centralized supervision of the operation of each station in the system. This is particularly true when it is a closed system which requires a smooth gradient of flow and pressure. Centralized supervision of individual station performance and control is both desirable and necessary.

The growing interest in this subject has prompted many manufacturers of electronic and communication equipment to enter this field. They are supplying electronic equipment which provides the necessary channels for transmission of control and supervisory signals, as well as the initiation and reception of desired operational intelligence. Some manufacturers design supervisory control systems according to the individual specifications of the customer.

Station down time necessitates controls . . . Almost 4 years ago, Sinclair's chief

Control Section

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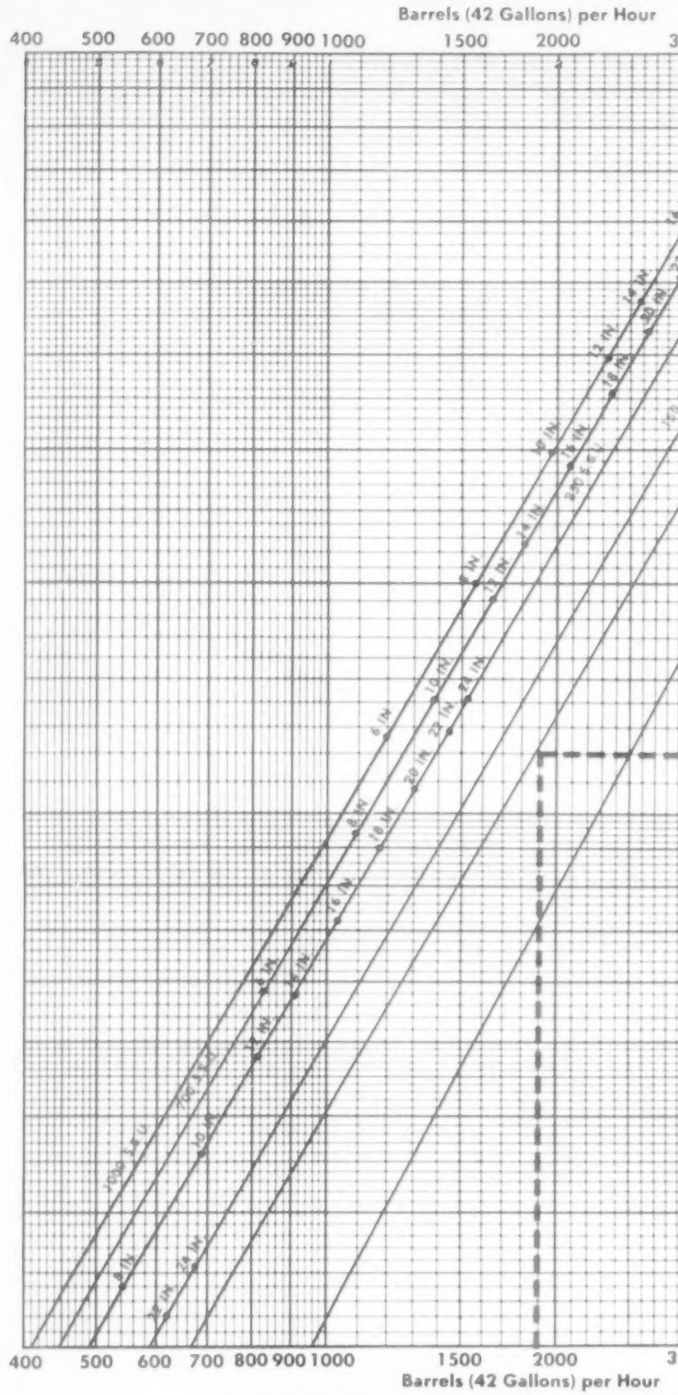
OIL-FLOW ANALYZER

FOR 6-24 IN. PIPELINES

(DEVELOPED BY SERVICE PIPE LINE CO.)

NOTE: This chart is established exclusively for tubulent flow. The nominal diameters marked on the viscosity lines indicate the minimum flow to insure tubulent conditions in that diameter line.



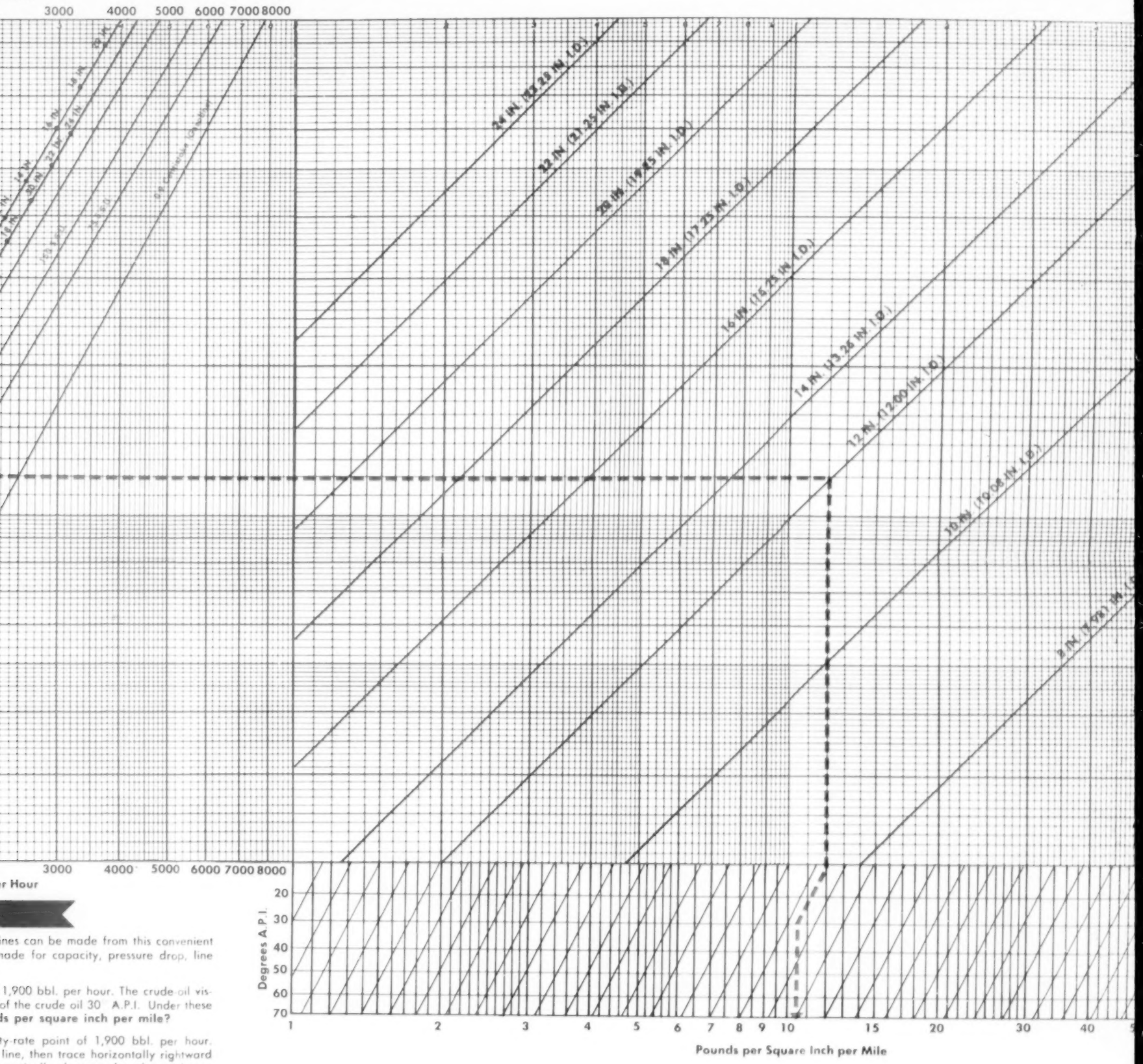
USE OF CHART

The solution for many problems in crude-oil and products pipelines can b grid (exclusively for turbulent flow). Variously, solutions can be made for size, etc.

Example: A pipeline situation is present involving a flow rate of 1,900 bb cosity is 75-S.s.U. The carrier is constructed of 12-in. pipe. Gravity of the cru conditions, **what will be the pressure drop in the line, in pounds per sq**

Solution: On the lower-left-hand horizontal scale, fix the capacity-rate p Proceed vertically until the projection reaches the 75-S.s.U.-viscosity line, then to the intersection with the sloping line for 12-in. pipe. Proceed vertically parallel to intersection with the 30 -A.P.I.-gravity axis. Next, proceed vert tion with the horizontal axis for pressure gradient. Here, read the pressure flow situation—**which is 10.5 psi. per mile.**

r Hour



r Hour

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nade for capacity, pressure drop, line

1,900 bbl. per hour. The crude-oil vis-
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FLOW LYZER

N. PIPELINES

RVICE PIPE LINE CO.)

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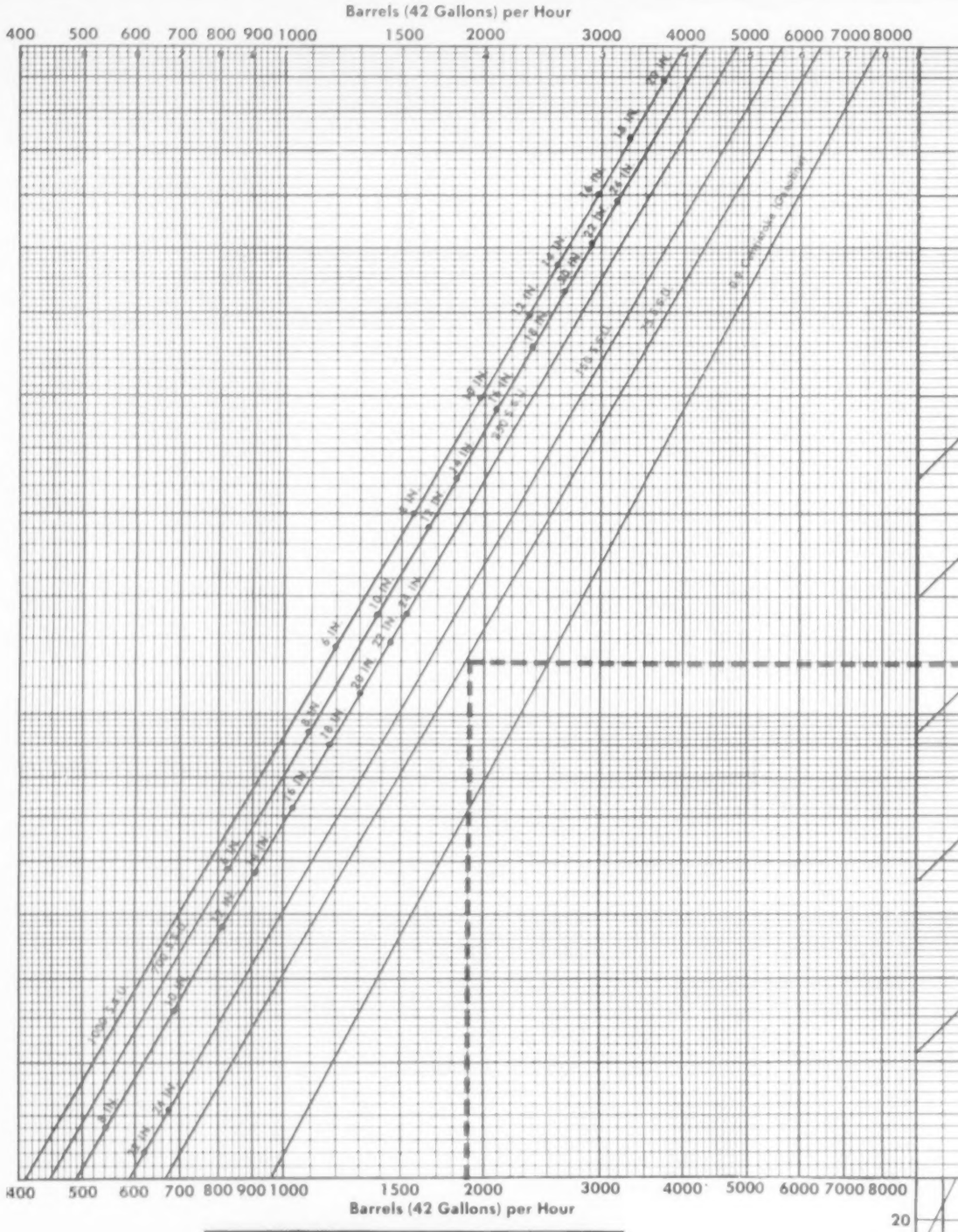
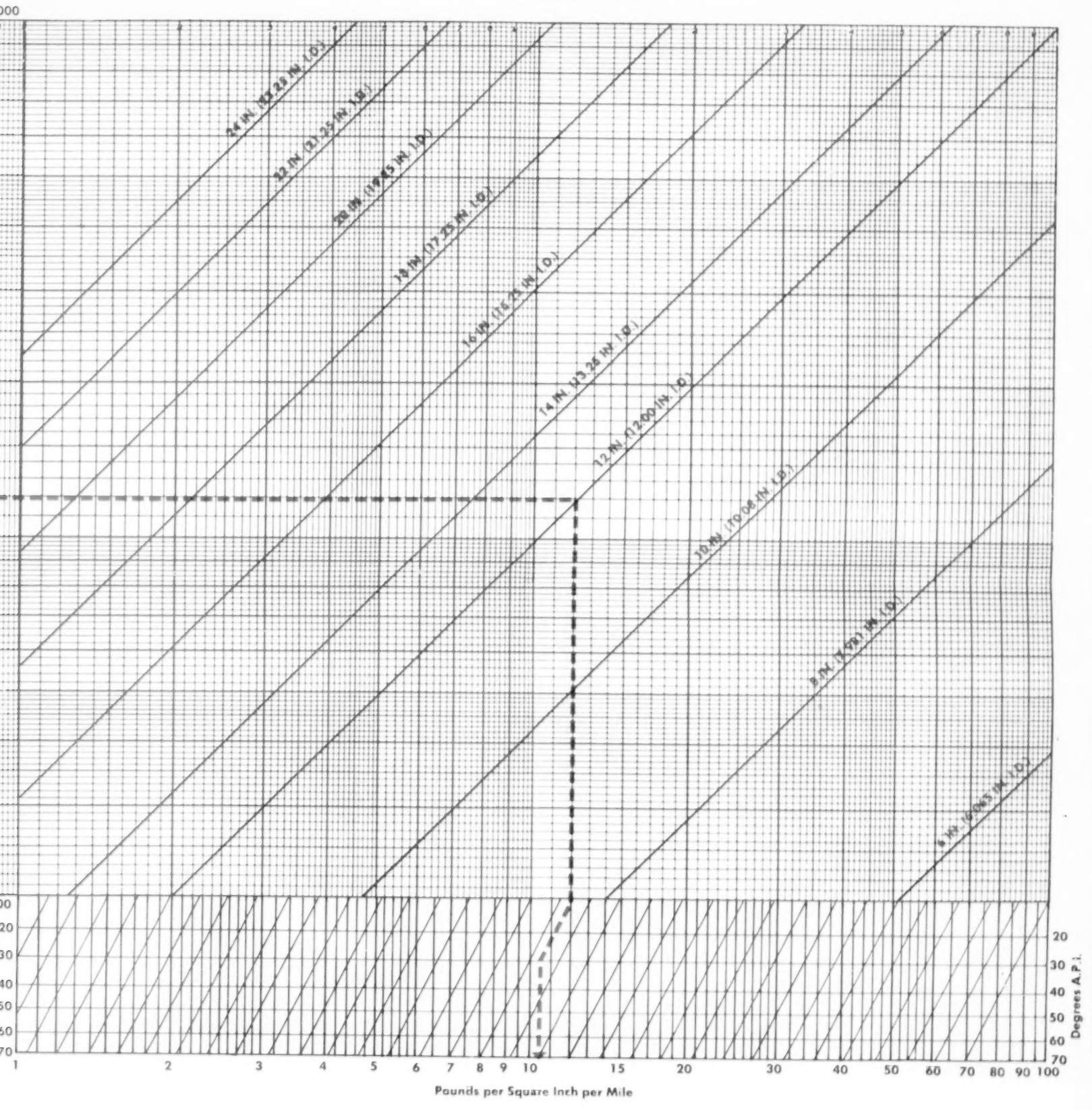


USE OF CHART

The solution for many problems in crude-oil and products pipelines can be made from this convenient grid (exclusively for turbulent flow). Variously, solutions can be made for capacity, pressure drop, line size, etc.

Example: A pipeline situation is present involving a flow rate of 1,900 bbl. per hour. The crude-oil viscosity is 75-S.s.U. The carrier is constructed of 12-in. pipe. Gravity of the crude oil 30 A.P.I. Under these conditions, **what will be the pressure drop in the line, in pounds per square inch per mile?**

Solution: On the lower-left-hand horizontal scale, fix the capacity-rate point of 1,900 bbl. per hour. Proceed vertically until the projection reaches the 75-S.s.U.-viscosity line, then trace horizontally rightward to the intersection with the sloping line for 12-in. pipe. Proceed vertically downward to base, thence parallel to intersection with the 30°-A.P.I.-gravity axis. Next, proceed vertically downward to intersection with the horizontal axis for pressure gradient. Here, read the pressure drop for the given pipeline-flow situation—**which is 10.5 psi. per mile.**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8 IN. (7.98 IN. I.D.)
6 IN. (6.065 IN. I.D.)
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Pounds per Square Inch per Mile
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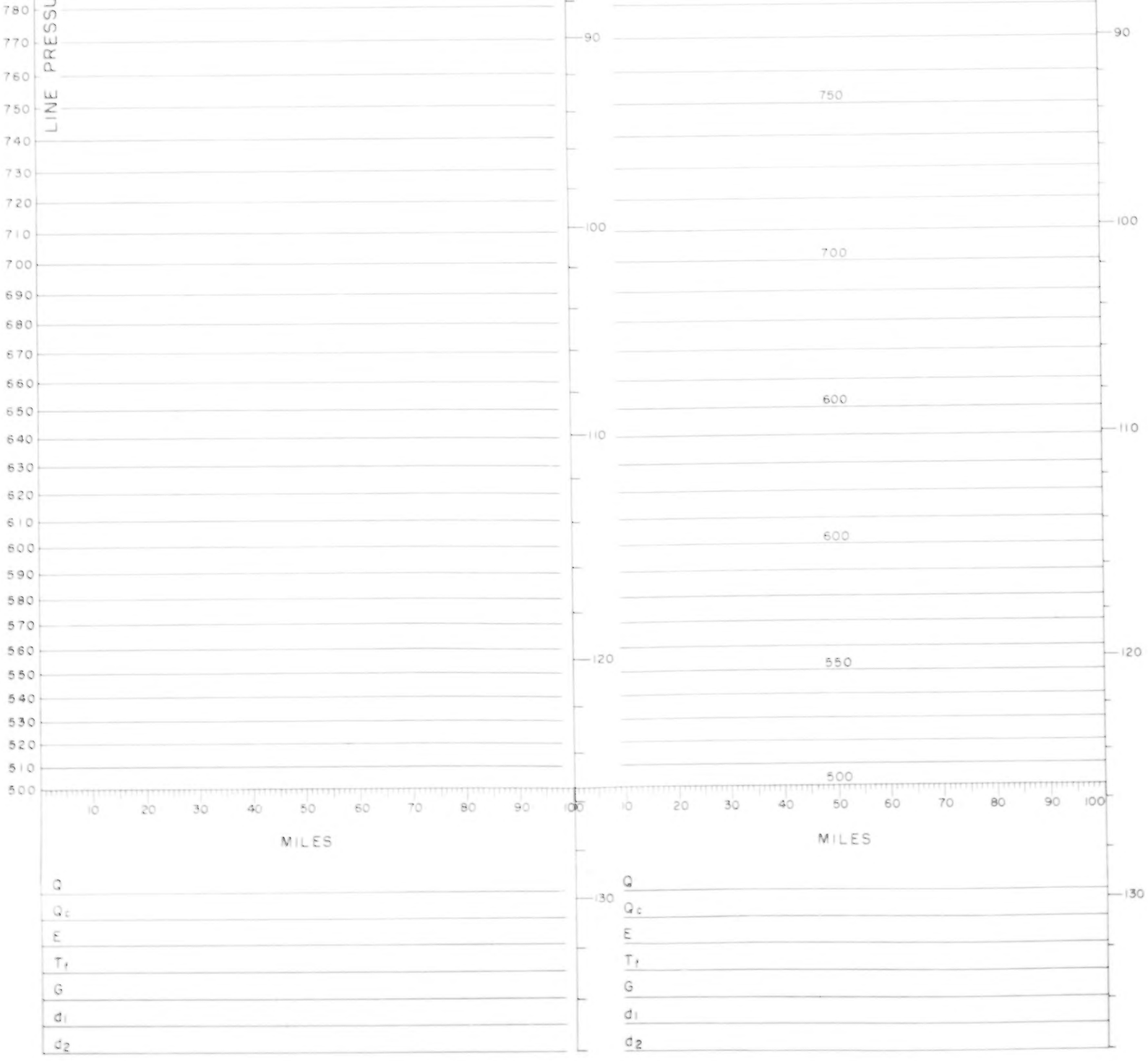
70
Degrees A.P.I.

The Oil and Gas Journal Presents

GAS—FLOW ANALYZER

FOR PIPELINE STUDIES — DEVELOPED BY C. W. MARVIN, TEXAS EASTERN GAS TRANSMISSION CORP.



HOW TO USE THE GAS-FLOW ANALYZER

Procedure for determining downstream pressure, P_2 (Also, see Problem I)

Knowing Q, P_1, T_f, G, E, and d and having the chart and two drafting triangles available.

(1) Mark off the distance L with a vertical line.
(2) Select H from Figure 5 or calculate it from Equation 5.
(3) Select F from Figure 6 or calculate it from Equation 6.
(4) Calculate Qc from Equation 4.
(5) Align the drafting triangles in first position to make a straight edge from the graph origin to the value of Qc calculated in Step 4 above.

Procedure for determining efficiency of a line, E (Also, see Problem II)

Knowing P_1, P_2, L, T_f, G, Q and d and having the chart and two drafting triangles available.

(1) Mark off the distance L with a vertical line.
(2) Mark P_1 and P_2 on the chart and draw a straight line connecting them.
(3) Using the triangles, place them with the slope triangle on the pressure distribution line drawn in Step 2 above.
(4) Move the edge of the slope triangle so as to intersect and cross through both the graph origin points and the Qc scale.
(5) Read Qc from the scale.

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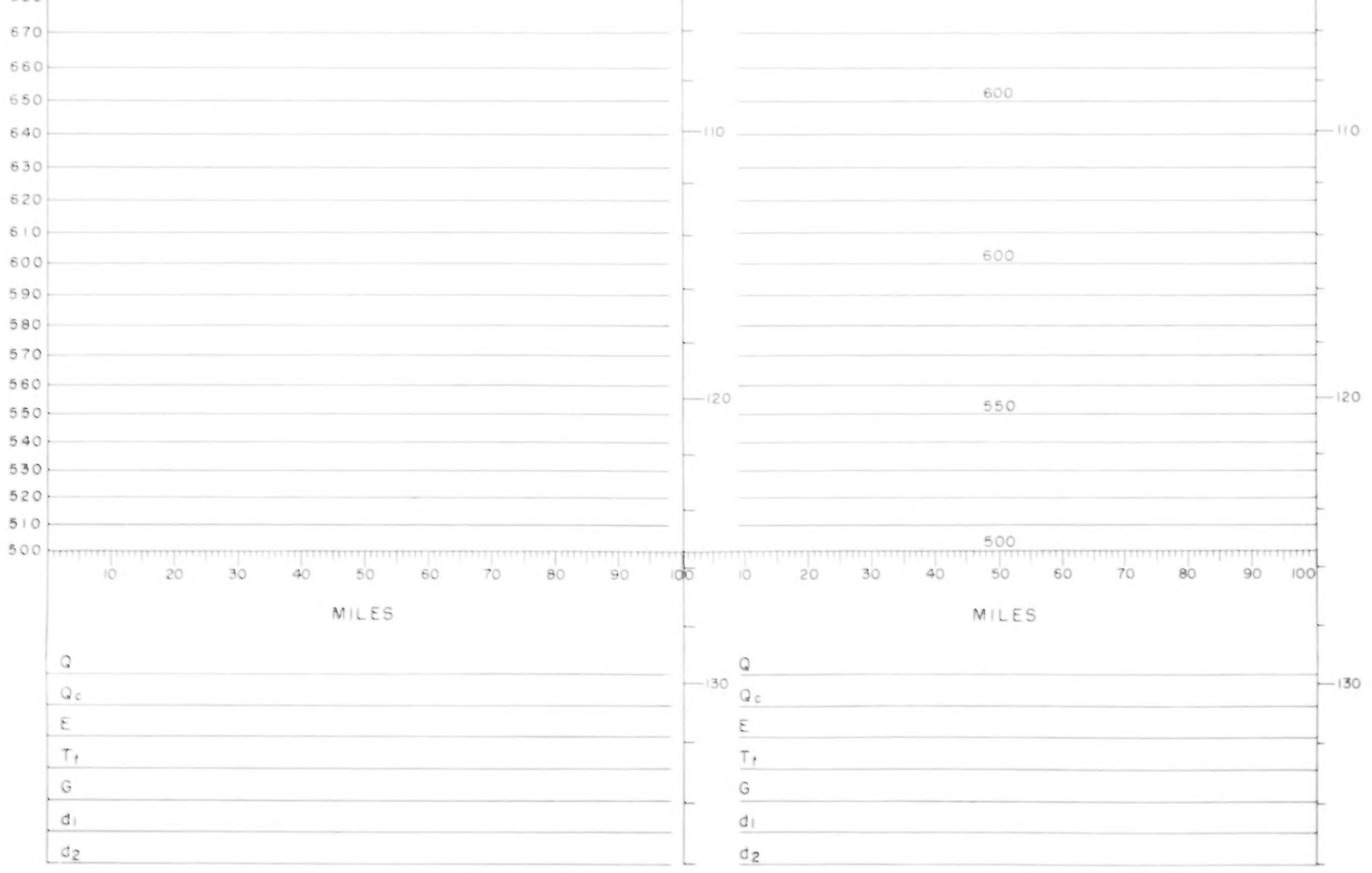
LINE PRESSURE PSIG



HOW TO USE THE GAS-FLOW ANALYZER

Procedure for determining downstream pressure, P_2 (Also, see Problem I)

Knowing Q, P_1, Tf, G, E, and d and having the chart and two drafting triangles available,

(1) Mark off the distance L with a vertical line.
(2) Select H from Figure 5 or calculate it from Equation 5.
(3) Select F from Figure 6 or calculate it from Equation 6.
(4) Calculate Qc from Equation 4.
(5) Align the drafting triangles in first position to make a straight edge from the graph origin to the value of Qc calculated in Step 4 above.
(6) Move the slope triangle to the parallel second position with the triangle edge crossing through the upstream pressure, P_1.
(7) Read P_2 where the slope triangle intercepts the distance L.

Procedure for determining capacity flowing, Q (Also, see Problem III)

Knowing P_1, P_2, L Tf, G, E and having the chart and two drafting triangles available,

(1) Mark off the distance L with a vertical line.
(2) Mark P_1 and P_2 on the chart and draw a straight line connecting them.
(3) Using the triangles, place them with the slope triangle on the pressure distribution line drawn in Step 2 above.
(4) Move the edge of slope triangle so as to intersect and cross through both the graph origin points and the Qc scale.
(5) Read Qc from the scale.
(6) Calculate Q from Equation 4.

Procedure for determining efficiency of a line, E (Also, see Problem II)

Knowing P_1, P_2, L, Tf, G, Q and d and having the chart and two drafting triangles available,

(1) Mark off the distance L with a vertical line.
(2) Mark P_1 and P_2 on the chart and draw a straight line connecting them.
(3) Using the triangles, place them with the slope triangle on the pressure distribution line drawn in Step 2 above.
(4) Move the edge of the slope triangle so as to intersect and cross through both the graph origin points and the Qc scale.
(5) Read Qc from the scale.
(6) Calculate E from Equation 4.

Procedure for determining length of loop required (Also, see Problem VI)

Knowing Q, P_1, P_2, L_1, Tf, G, E, d_1 and d_2 and having the chart and two drafting triangles available,

(1) Mark off the total distance L_1 with a vertical line and also mark P_1 and P_2 on the chart.
(2) Select values of H (from Figure 5 or calculate them from Equation 5) for the main pipe of d_1 and also for the two looped pipes in parallel, d_1 and d_2.
(3) Select values of F (from Figure 6 or calculate them from Equation 6) for the main pipe of d_1 and also for the two looped pipes in parallel, d_1 and d_2.
(4) Calculate Qc from Equation 4 for the single pipe and for the double pipe.
(5) Align the drafting triangles to fit the slope from the graph origin point to the value of Qc for the double (looped pipe) and draw a parallel line from P_1 toward P_2.
(6) Align the drafting triangles to fit the slope from the graph origin point to the value of Qc for the single (unlooped section) and draw a parallel line from P_2 toward P_1, crossing the line drawn in Step 5 above Point X.
(7) Read the mileage from P_1 to X. This is the amount of loop line (d_2) required.

Published by The Oil and Gas Journal, supplement to issue of September 20, 1954
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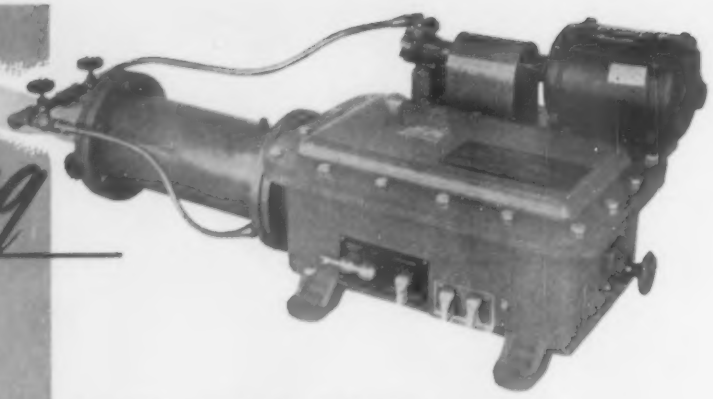
Announcing



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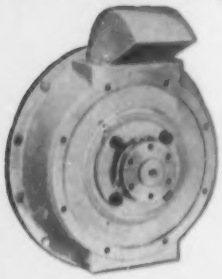

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THE AUTHOR

S. M. Hammer's experience in the communications field began immediately following his graduation from Lane Technical High School in Chicago. He was first employed by the old Swedish American Telephone Manufacturing Co. and in 1918 joined Kellogg Switchboard & Supply Co. He worked in that company's experimental and radio laboratories, where he experimented with radio-receiver design and application of carrier frequency to exchange cable systems. In 1932 Hammer joined the predecessor company of Sinclair Pipe Line Co. to design and produce an impu'se-type tank gage, and to redesign an existing selsyn-type, water-tank gage for application to oil-tank gaging. In recent years he has designed and supervised the construction of several wire-chief's test boards. Hammer is currently directing his efforts toward the modification of existing microwave terminal equipment for the adaptation of dial signaling on separate, but coordinated, microwave systems.

dispatcher expressed a desire to monitor and control the operations of some of the small unattended gathering stations along the system. These stations were being started by a district gager who used a time clock to control the number of hours the unit was to run. Quite a number of unattended units operated daily in this manner.

These units would frequently shut down, due to power failure in most instances. These shutdowns were made known to the chief dispatcher by decrease in the main-line flow, which is reported hourly, but the dispatcher had no way of knowing whether a unit had shut down, or whether the decrease in flow was due to a line break. It was necessary for the dispatcher to locate the gager. The gager frequently needed to do nothing more than push a starting switch to correct the difficulty, but many hours of operation may have been lost.

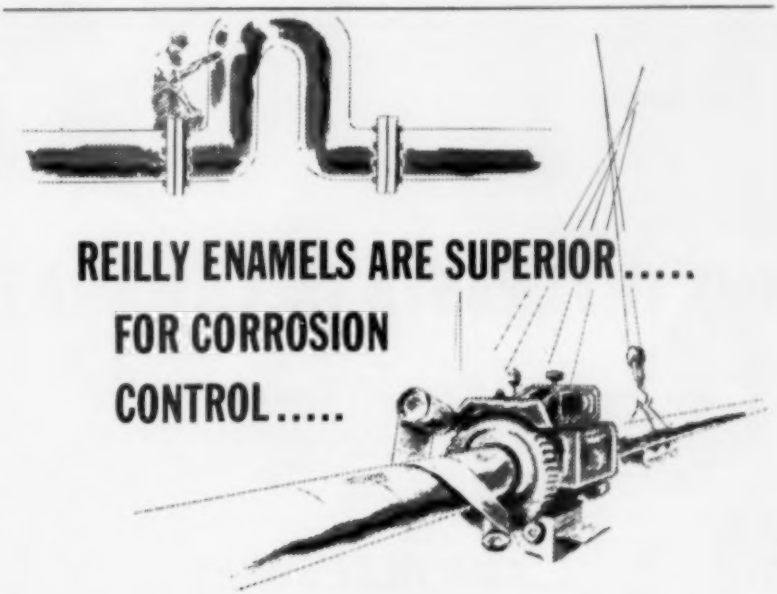
The accompanying photographs show a monitor and control unit the author designed for the purpose of eliminating these delays, with their consequent anxiety for the dispatcher, the loss of oil, accumulation of mileage expense, etc. With this relatively simple device the dispatcher can monitor at will all of the stations within the system. A number of these units are in use on the company's gathering system in Kansas, Oklahoma, Texas, and Wyoming.

System operation . . . This equipment is housed in a steel cabinet suitable for either indoor or outdoor locations, and is easily installed at the station location. No other equipment is needed at the control point. The dispatcher uses his existing telephone and ringing facilities, normally used for making telephone calls. When he desires to contact a station to determine its operating status, and, if necessary, to start or stop the unit, he simply rings a series of coded ring signals the same way he would ring on a telephone party line.

The first code causes the control unit to be placed across the telephone line. A second code ring will cause the pump unit to start, while a third code ring will cause the pump unit to stop. Other codes may be added to handle other functions if desired.

When the first code has placed the unit across the line, a series of relays operate which accomplish the following: a timing motor starts up which allows the unit to remain across the line for about one minute. A telephone transmitter is energized to pick up different sounds and certain circuit closures are made which permit the performance of other selected functions if so desired. A cam-operated switch on the timing motor causes a buzzer to sound (according to the station code ring which is cut on the periphery of the cam).

The buzzer sounds are transmitted over the telephone line and inform the dispatcher whether or not he has se-



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lected the desired station, which in most cases is not the only one on the party line. Immediately thereafter a chime sounds if starting power to the pump motor is available. If the pump motor is running, the telephone transmitter (which is in a housing that is usually bolted to the pump-unit frame) will transmit the sounds of the running unit back to the dispatcher. Absence of these sounds indicates that the unit is not running.

To start or stop the unit he merely rings the required code ring. This causes the proper start or stop relay to operate to perform the desired function.

To preclude false operation of the pump unit by accidental ringing of the code rings assigned to a particular station by the normal rings assigned to party-line telephones, all of the code rings necessary to place the monitor on the line and start or stop the unit must be done within the 1-minute period following the activation of the monitor and control unit. A further safeguard against accidental operation is provided in the operation of the selector which responds to the coded rings. This selector requires a longer-than-usual ring before it will function.

The device herein described is versatile, and can be easily adapted to various operating conditions. For example, one adaptation involves the control of a given station by either of two adjacent stations. Such control can be carried out independently of the master controls at system headquarters.

Adaptation to dial systems . . . A modification permits its use over telephone circuits using dial signaling. The functioning of this modification might be summarized as follows:

The station to be controlled or monitored is selected by dialing, and the pumping unit is started or stopped by a second selection, which activates the appropriate relays.

False dial selection is eliminated by a lockout arrangement which prevents the accumulation of dial pulses contained in a multiple digit number from adding up to the number for a "start" or "stop" function.

A timing motor allows the monitor unit to remain across the line for a period of only one minute following its selection by the control point.

The station may be reselected 4 to 8 minutes later to determine if the pumping has started or stopped.

Operating experience with this device will undoubtedly combine with imaginative inventiveness in leading to new adaptations and usages, which will make such a remote-control mechanism increasingly valuable.

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Edmonton, Alberta, Canada

New Plant Licks Pipeline Gas Problem

(Continued from page 180)

of 75 million cubic feet per day of residue gas are incorporated in the original construction. Designed operating pressure is 1,000 psi.

The design of the plant follows the conventional plan generally in use for acid-gas removal, with the addition of an amine-solution recovery unit. This recovery unit, similar to a solid-desiccant dehydration plant, consists of two horizontal adsorbers containing solid desiccant and the necessary desiccant reactivating gas heaters, coolers, and liquid accumulator. The purpose of the recovery unit is to adsorb the amine solution which would otherwise be carried over into the transmission system with the sweet gas. This solution is recovered from the desiccant by reactivation and returned to the plant solution storage.

Carbon dioxide removal is acomplished by countercurrently contacting the sour gas with a 20 per cent monoethanolamine, 80 per cent water solution in two 6-ft. diameter by 56-ft. 6-in. high vertical contactors having 25 bub-

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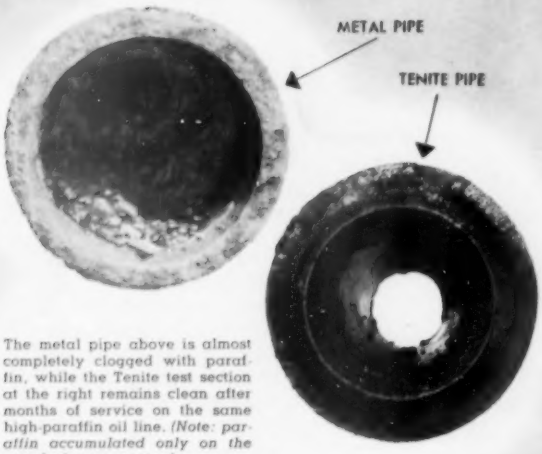
The low frictional resistance of Tenite Butyrate's smooth interior wall gives you up to 40% greater flow volume than does metal pipe for the same head loss.

Butyrate pipe means less maintenance

You can bury Tenite Butyrate pipe without corrosion worries. Tenite resists corrosion by sour crudes, salt water and electrolytic soils.

Butyrate pipe means less downtime



The metal pipe above is almost completely clogged with paraffin, while the Tenite test section at the right remains clean after months of service on the same high-paraffin oil line. *(Note: paraffin accumulated only on the metal pipe connector.)*

What problems could Tenite Butyrate lessen for you?

TENITE BUTYRATE PIPE ends many of the troubles you encounter with metal pipe. For example, using Tenite, you can quickly cross off corrosion failures. If paraffin accumulation has been your problem, you'll find that few, if any, cleanings are necessary when your paraffin-laden crudes are sent through Tenite lines.

Does your pipe have to be hauled over long, difficult distances? Then, you'll like the light weight of Tenite—it is only 1/12th as heavy as the cement-lined metal pipe you may now be using. Tenite even helps your pumping costs, lets you use smaller pumps and less power. Best of all, Tenite is the easiest pipe to install. You just solvent weld slip-sleeve couplings to the pipe ends.

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OG-954

THE AUTHORS

A. L. VAUGHAN

R. B. McLAUGHLIN

A. L. Vaughan is superintendent of compressor and process plants for Northern Natural Gas Co. at Omaha, and R. B. McLaughlin is process engineer for the same company, also at Omaha. Both of these men have been associated with the natural-gas and gasoline industries for over 30 years.

ble-cap-type trays each. The treated gas then passes from the top of the contactors through a sweet gas scrubber to the solution recovery unit and on into the transmission system.

The foul solution flows from the bottom of the contactors through liquid-level-control governors into a vent tank to effect a pressure reduction which then permits absorbed hydrocarbon vapors to flash into the boiler-plant fuel system. From the vent tank the solution passes through the tubes of four shell-and-tube-type heat exchangers to the solution-regenerating still. A flow-control governor is located between the heat exchangers and still to maintain vent-tank pressure on the exchanger tubes and prevent excessive liberation of acid gas in these tubes. The still is 11 ft. in diameter by 62 ft. 6 in. high and has 19 bubble-type trays. Heat for the solution regeneration is furnished in two 50 by 78 by 240-in. kettle-type reboilers.

The regenerated sweet solution flows from the still bottom through the shell side of the previously mentioned heat exchangers and into a surge-makeup tank. Booster pumps then move the solution through a 16-section fan-type aerial cooler and a four-section shell-and-tube water cooler to the primary amine solution circulating pumps.

The still overhead is cooled in a four-section fan type aerial condenser, with the condensate going to an accumulator and the carbon dioxide to a flare. The condensate is pumped back to the still as reflux.

Three 6-in. six-stage solution circulation pumps (two operating, one standby) are installed for pumping the amine solution over the contactors. The normal capacity of each pump is 1,080 g.p.m. These pumps are driven by 1,085 hp. steam turbines. Turbine speed is controlled by rate of flow meters in the solution pump discharge lines. At design conditions the amine solution circulation rate is 2,160 g.p.m.

Superheated steam is furnished by three 80,000-lb. per hour water tube-type boilers. In operation two of these boilers are required to furnish power to drive the amine-solution pumps, boiler-feed-water pumps, and boiler induced-draft fans and the third is a standby. Desuperheated exhaust steam from the amine solution pump turbines is used in the still reboilers to supply the heat for solution regeneration. The steam condensate from the reboilers is deaerated prior to being returned to the boiler-feed-water system.

Plant lighting and electrical power required to drive aerial cooling fans, solution booster pumps, water-well pumps, water-circulating pumps, generator engine-jacket cooling-water pumps, air compressors, and all other appurtenant equipment are furnished by two 715-kw. gas-engine-driven generator units, one operating and one standby.

Two deep water wells furnish the water required for plant operation and domestic consumption. An evaporator is used to condition the makeup water for boiler feed, generator engine cooling, and amine-solution concentration.

Plant communication facilities are local telephone, leased wire service to Permian's home office, and short-wave radio.

The plant operating personnel consists of 16 people. Fourteen of these are housed in company cottages at the plant site.

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Here's Why They Chose Microwave

(Continued from page 175)

carrier was investigated and quotations received and these costs were relatively high.

The problem of outages on common carrier was one of concern. We knew the outage would be taken care of, but how quickly was another question. Suppliers of common-carrier facilities have not always grasped the problems of the gas-transportation company in the urgent need for reliable service.

In gas-transportation-company operation, communication to various fields and stations is most important, bearing a similar relation as the brain and the body. One can't function without the other.

When the gas-transmission company's own telephone line fails, no effort is spared in restoring communication. What would happen when common carrier failed in an isolated area? Would due diligence and effort be exercised? From previous experience and reports from other sources, we believed common carrier would not be in a position to exert the same effort our own personnel would.

A further consideration was the fact that additional channel costs on common carrier were not inviting.

From these facts it became apparent that wire line and common carrier offered a dull picture for the type of communication this company needed now and for future development.

Microwave selected . . . The third method available was microwave, the infant of the communication field. Microwave offered many advantages. It provided relatively easy maintenance, static-free operation, and was economically equal to wire line or common carrier. And it had the added attraction that the more numerous the channels, the cheaper in comparison it became.

In addition, such a microwave system made it possible to integrate into our already established VHF radio system more stations and mobile units and thus increase the efficiency and scope of our radio system. This was very important to us. It offered almost unlimited future possibilities, such as telemetering channels, facsimile, teletype, additional voice channels, remote control of unattended stations, and a service channel—all at a relatively small cost.

We were fortunate in having our office building almost at the foot of Cheyenne Mountain, a 9,000-ft.-elevation peak which rises sharply from the plains of eastern Colorado. From this commanding elevation we had already erected a VHF fixed station and successfully operated for years, contacting stations well over 100 miles distant.

A road up this mountain is maintained all year round. Power from the city system also is available, and we had a standby generator in the radio building as well. We were fortunate in having secured from the owner of this mountain authority to erect our radio station and he extended his permission to include microwave operations.

A local contractor erected a Duralite building almost on the top pinnacle of this mountain. To get material to this spot, we built a wooden railroad about 500 ft. long, climbing at an angle of 45° or better. On this we set a small car and, with a winch, hauled material and men to the building site.

Boulders in place were used to help anchor the building. On two sides was a drop of at least 1,000 ft. to the ground below. Work was carried on in October when normally some severe snow storms would occur. Fortunately, the weather generally was in our favor and the construction of the building was completed without any untoward incidents.

The microwave system originates at

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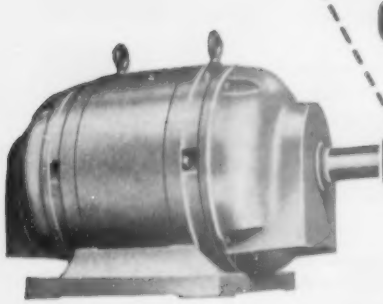

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a terminal station in our main office building in Colorado Springs. The fault-indicator equipment is in the dispatching office and radio equipment is located in a building on the roof. This latter building was constructed by the same contractor who erected the shelter on Cheyenne Mountain. All other buildings and towers were handled by J. D. Trilsch Co.

Microwave path . . . From the top of our office building the microwave path goes to Cheyenne Mountain, a distance of 6 miles. From there it goes to a spot known as Todd Point, some 81.5 miles southeast in an isolated area served with power from the R.E.A. From Todd Point, the microwave again goes southeastward to a point called Cedar Crest, a distance of 56.3 miles. From this point we had our telephone crews construct a 4-mile-long wire line to our compressor station at Springfield, Colo. Also at Cedar Crest we erected a VHF station which can be controlled from either the central dispatch office or from the Springfield compressor station.

From this station the microwave then beams a distance of 30.0 miles to an unattended repeater station and then goes to our compressor station in Morton County, Kansas, a distance of 30.5 miles.

The beam then is directed south into Oklahoma a total of 25.5 miles, and terminates at our compressor station near Keyes, Okla.

Our company employed Microwave Services, Inc., V. J. Nexon, engineer, to plot a recommended path line for the system. We were interested in determining the optimum microwave paths with due consideration given to economical and technical factors. Path clearance requirements, antenna systems, tower heights, propagation reliability, and possible site locations were all given complete study in choosing the final path.

The method used consisted of aerial reconnaissance, mapping field observation, and altimetry. This survey was concluded and a report submitted. From the information and recommendations, our electrical-engineering department made the final decision concerning beam width and equipment.

Equipment choice . . . We adopted the 2,000-mc. band, using R.C.A. CW-20A equipment for microwave relay, Lenkurt for multiplexing, parabolic antenna reflectors, and Prodelin coaxial line for the transmission lines.

We had a number of unusual problems to settle. For example, the original aim was to provide a terminal station on Cheyenne Mountain. From there the multiplex and fault circuits would

TERMINAL EQUIPMENT, located atop Colorado Interstate's main office building in Colorado Springs, is checked by L. F. Colgrove, chief foreman of the company's communication department.

extend over wire lines to Colorado Springs. Use of No. 22 A.W.G. exchange cable for distances of more than 5 miles is not economical, as it does not permit expansion of voice facilities for the future without additional costs in equalizing the wire line. Therefore we abandoned this thought because the distance involved was more than 5 miles.

The long hop, 81.5 miles to Todd Point, showed abnormal light refraction during calm, hot, clear days and we expected fading over the long path within the margin provided. The path crosses over an irrigated populated area of farms with trees and other vegetation. Leaving this area the path crosses rising ground into an area of dry, windblown, flat land, devoid of trees. From there the path swings on over numerous normally dry creeks and across treeless grazing land to Todd Point at the southern end of a rising ridge.

At this point we installed an emergency generator. We learned in the very early part of the year that this location was subject to violent dust storms as were all the others in the system except Cheyenne Mountain.

The dust that blows in this area is exceedingly fine; it resembles brown face powder and is capable of penetrating the smallest opening. For 8 weeks we battled the dust problem and then installed a combination of equipment which solved the problem. We designed and installed dust precipitators and Breidert air exhaust ventilators at these locations. Dollinger dry-panel air filters were also used. Buildings at these sites are of Duralite block construction, fully insulated, and heated with electric heaters, but are not air conditioned.

Channel utilization . . . Another interesting feature of our system is the service channel which provides communication for maintenance purposes between the stations and handles fault-indication signals. This channel is equipped with 285-cycle ringing apparatus for code signaling between stations. The unit has fault indication equipment for recording six different types of faults at the main office and Springfield.

The channeling equipment used with the microwave equipment to provide the signaling circuits and the individual voice circuits of the system uses the frequency division method of multiplexing. The equipment, in addition to providing the above type of communication, is designed to permit other functions, such as teletype, telemetering and supervisory control, to be carried on simultaneously. The voice channel units are of the single-sideband, suppressed-carrier type, which is a basic method used and widely accepted by the telephone industry.

The individual units are simple in design and use standard type vacuum tubes for voice operation and ringing. Thirty-cycle ringing current, either manually or dial controlled, can be used for ringing on the individual channels. Due to the wide use of this type equipment in the telephone industry, many service men are experienced in the operation and maintenance of this apparatus.

As for performance, it is too early to localize or give statistics. We can say that outage has been insignificant and maintenance negligible to this date.

We did not add extra personnel to operate the new microwave system but we did shift the location of some men to better utilize their services. We have found that our radio technicians are able, with supplemental training, to service and maintain the equipment along with other duties.

THE AUTHOR

W. I. Blount, chief dispatcher, Colorado Interstate Gas Co., joined the natural-gas-transmission company in 1937 in its purchasing office. He transferred to the dispatching office in 1942 and the following year became acting chief dispatcher. In 1946 he was put in charge of communications for Colorado Interstate and has witnessed the steady expansion of communication facilities, climaxed by the installation and operation of a microwave system. A native of Colorado Springs, location of Colorado Interstate's general offices, Blount attended Colorado College prior to joining Colorado Interstate.

Transco Maintains 1,780 Miles of Microwave

(Continued from page 177)

propagation. Our experience indicates that fades occur with more severity along the Gulf Coast than any other section of our system. Two other bothersome small areas exist, one of which is in the vicinity of Atlanta and the other along the Potomac River. In each place fog layers are prevalent, which means high humidity and low turbulence. It is quite common to find 15 to 20-db. fades over a period of 8 to 10 hours along our system with the phenomena being more pronounced in the Gulf Coast area. In many instances fades are accompanied by overshooting of signals with these being observed to skip more than 160 miles at fairly regular intervals.

Increased signal strength or improved receiver sensitivity can effectively combat most fading problems, especially in our service where interruptions of short duration are not a major problem, particularly if they occur at night when service requirements are at a minimum.

Standby power . . . Another source of trouble we encounter is with equipment auxiliary to the microwave gear. Auxiliary power supplies as designed and delivered to the system were not particularly applicable to our service requirements. Starting batteries in the units had very short life when used in intermittent service. Also, trickle chargers kept batteries dry. Power changeover equipment, (relays and cutouts) are a source of outage time.

Failure of auxiliary power supplies would not be so large a factor if the annoyance of unreliable commercial power sources did not exist. In our system we purchase power at 42 locations, with 2 of the installations having interruptions as high as 25 each per month. One contributing factor to our power interruptions is that a large percentage of our line is located where lightning storms have given us up to nine power interruptions at one location in a single day.

Heat and dust, high on the list of undesirable occupants of the equipment buildings, are each responsible for considerable outage time. High temperatures will materially shorten tube life, while the air circulated to lower the high temperatures brings in troublesome dust. There is also a tendency for maintenance personnel to neglect routine work when summer heat combines with equipment heat in the buildings. Air which is circulated to lower building temperatures to outside temperature, or as nearly as possible thereto, brings in fine dust which causes automatic switching relays on standby equipment to malfunction. Filtering of the air only slows the process and does not cure the dust problem. Therefore, the necessary cooling of the equipment brings on another problem of relay maintenance.

The above problems are emphasized in an effort to be helpful to those having or contemplating microwave installations. Additionally, I would like to stress the fact that the microwave art is still in its semiinfancy with additional developmental work essential to encourage the continued rapid expansion of this new communication tool.

THE AUTHOR

Robert H. Buechner is senior engineer for the communications department of Transcontinental Gas Pipe Line Corp. He was graduated from Iowa State College in 1943 with a B.S. degree in electrical engineering. In that year he joined the microwave section of General Electric Co. at Syracuse. He held this position until 1950 when he came to Transcontinental.

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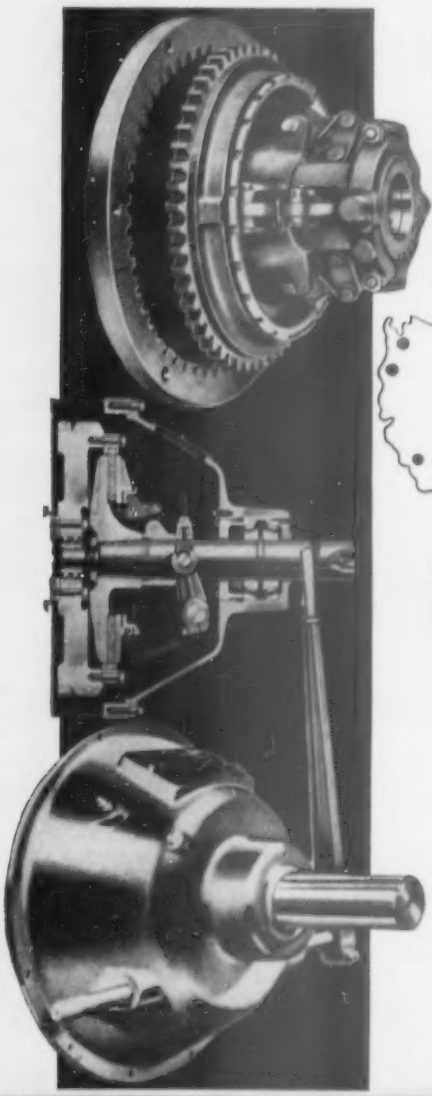

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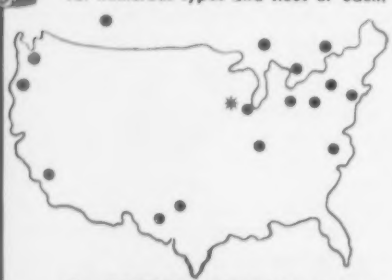

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Renewed Vigor for Old Gas Engines

(Continued from page 168)

ously mentioned is demonstrated in Figs. 6 and 7.

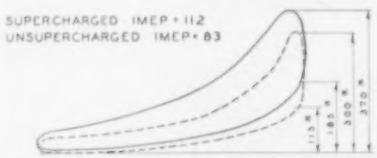
In Fig. 6, a low-spring card taken with a 20-lb. spring on the supercharged cylinder is shown. The exhaust back pressure is sufficiently high that it causes the negative work as indicated by the diagonally crosshatched area. During the exhaust stroke the back pressure is reduced enough so that it becomes lower than the blower discharge pressure, and the blower pressure creates an area of positive work as indicated by the vertically crosshatched area.

Fig. 7 shows what would have happened if the No. 1 right-hand cylinder followed the No. 1 left-hand cylinder by 90° as in the standard engine arrangement. The crosshatched area shows the negative work which results on the left-hand cylinder from this arrangement.

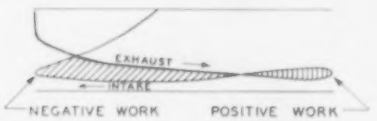
A study of the cards indicates that approximately 50 per cent of the energy which drives the turbine is obtained from the pulses which do not result in equivalent back pressure on the power pistons and the other 50 per cent is produced by the back pressure. This latter power is therefore in effect being directly produced by the power pistons during the exhaust stroke.

Valve settings . . . In the experimental work to date, we have attempted to determine the valve timing which will result in the best efficiency as well as the coolest operating cylinder.

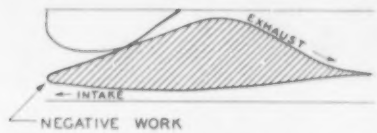
We tried overlaps between the opening of the inlet and the closing of the exhaust varying from 112° to 152° and compromised on 132°. The largest overlap, although desirable from a cylinder-cooling standpoint, has resulted in too high a fuel consumption. The exhaust temperatures with the 132° overlap



TYPICAL CYLINDER INDICATOR card gives a ready comparison of the engine's performance before and after supercharging. Fig. 5.



CYLINDER INDICATOR CARD taken with light spring shows the small amount of work done on the exhaust gas during the exhaust stroke. Fig. 6.



SIMILAR CARD, taken before changing firing sequence, shows that high back pressure required a considerable amount of work during the exhaust stroke. Fig. 7.

THE AUTHOR

C. S. Kenworthy, general superintendent of compressor stations for the Natural Gas Pipeline Co. of America, has been associated with gas pipelining and its equipment for over 30 years. He graduated from Cornell University in 1923 and held several positions with Worthington Pump & Machinery Corp. until 1938. At that time he joined Natural Gas Pipeline Co. and for the last several years has been in charge of the compressor station department for that company and for Texas Illinois Natural Gas Pipeline Co. and Natural Gas Storage Co. of Illinois.

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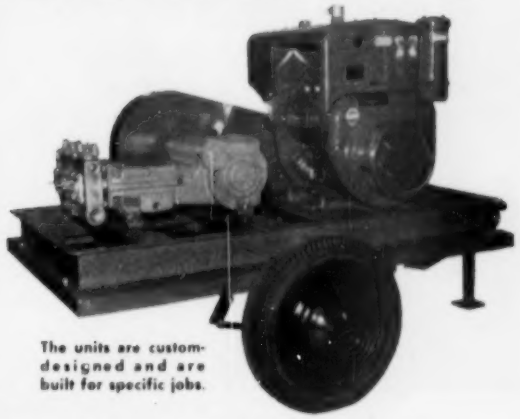

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even with 90° atmospheric temperature averaged only 850° at 1,825 indicated compressor horsepower which was considered satisfactory. The maximum combustion pressure under these operating conditions was only about 375 psi.

Higher peak pressures will of course improve the fuel consumption slightly, but to increase the cylinder pressures above 400 psi. is considered ill advised at present. Tests were conducted, however, to determine the effect on economy of increasing the combustion pressure. This was first done by holding the ignition at 20° in advance of top dead center and enriching the mixture. In the second method, the mixture was held constant and the ignition was advanced to 25° before dead center. The engine was operated at 1,750 compressor horsepower indicated and at the rated speed of 125 r.p.m.

The results were as follows:

1. Combustion pressure increased to 500 psi. by enriching mixture. Exhaust temperature increased 50° F. Blower discharge pressure decreased from 13.0 to 10.6 in. of Hg. Fuel consumption was lowered 3.4 per cent.

2. Combustion pressure increased to 450 psi. by advancing spark from 20° before dead center to 25°. Exhaust temperature decreased 45°, or 95° lower than with the rich mixture and the 20° spark advance. Blower discharge pressure decreased from 13 to 11.5 in. of Hg. Fuel consumption was lowered 4 per cent.

The pulsation which occurred in our fuel-gas orifice metering run with only one engine operating resulted in high fuel readings. We have therefore not referred to absolute fuel readings in this article although we believe that the fuel consumption of this unit is comparable to or slightly better than the standard engine.

Results have been sufficiently encouraging that we are proceeding to supercharge the four remaining engines at our Hooker station. When these engines have been converted, we will be able to conduct additional tests at varying speeds and loads, and will be able to check the fuel consumption closely.

Although no attempt has been made to date to cool the air to or from the blower, we hope to determine the effect of evaporative cooling on the performance of these engines later.

Engine loading methods . . . Up to now nothing has been mentioned in regard to the loading of a supercharged unit.

In our particular case, by replacing the 12⅝-in. cast-iron liner with a 14-in. steel liner with a thin cast-iron inner liner, we were able to increase the loading to 1,750 compressor horsepower at the plant operating conditions. This does not result in an overload on the engine frame nor on the compressor cylinder. However, to be entirely safe we are replacing the compressor piston rods with rods which are integrally forged with the pistons.

In some instances where the suction pressure is low and the pressure differential is very high, and where compressor cylinders with large clearance volumes are in use, the engine frame might become overloaded. An increase in piston and liner diameter, even though it is physically possible to accomplish, could conceivably create too great a load. In this case it might be possible to design a cylinder with a small clearance volume and a smaller diameter piston which would result in the proper horsepower and capacities.

A word of warning in regard to the cooling system is in order. The majority of horizontal installations are equipped with open cooling systems and evaporative-type cooling, and there is always more or less scale present in the cylinder jackets. Unless these systems are operated with a very minimum of scale, the supercharged engines with the increased heat load might become a problem.

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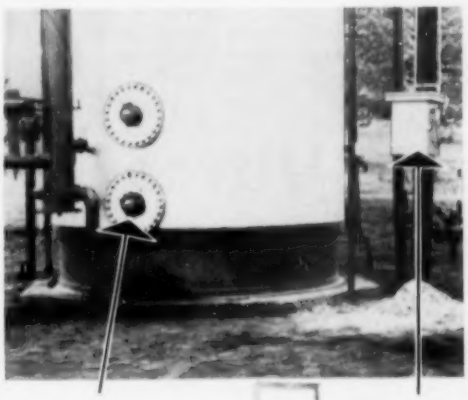

Above: 2 of the 5 CPS Heater-Treater Anode Installations and Good-All divided-circuit rectifier shown in operation.

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CPS Heater-Treater Anode shown assembled ready for Horizontal Mounting.

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CURRENT DENSITY (MA)	POTENTIAL ($CUSO_4$)	TEST PLATE WT. LOSS (GRAMS)
0	.7	30.2
5	.83	2.4
10	.856	0

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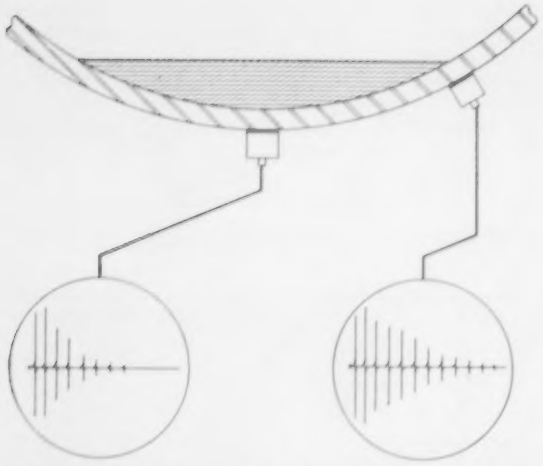
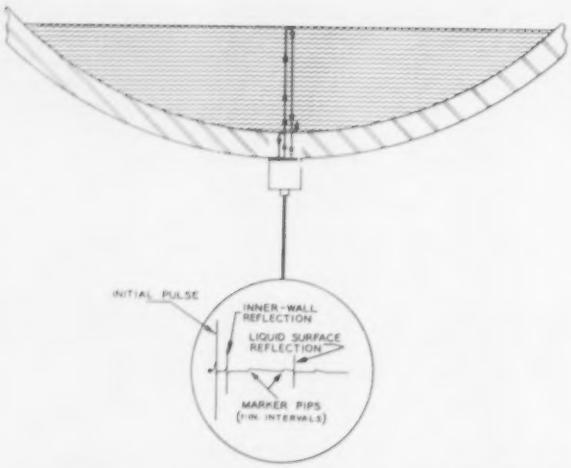


IN MOVING up the side of the pipe with a crystal transceiver, the change in oscilloscope pattern becomes a liquid depth measurement. Fig. 1.



IN THE PENETRATION METHOD, the scope is calibrated so that the reflected wave's position is a direct indication of liquid depth. Fig. 2.

Are Ultrasonics Practical for Finding Liquid Accumulation in Gas Lines?

by R. G. Deering
Assistant Pipeline Editor

Tests for presence of liquids within gas pipelines of El Paso Natural Gas Co. have recently been made using ultrasonic equipment and newly developed techniques. The general method appears sound and promises to reveal heretofore unknown facts concerning two-phase flow within pipelines.

A SERIES of tests have recently been completed on lines of El Paso Natural Gas Co. under operating conditions to determine the practicality of using ultrasonics to indicate presence of and to measure depth of any liquids present in the lines.

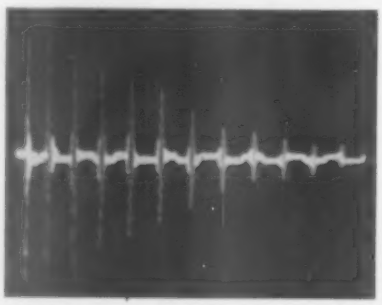
Results of the tests indicate that acoustical energy with frequencies in the megacycle range may be utilized for such measurements but that methods and equipment presently available have definite limitations.

Generally, it was found that such tests will show the presence of oil or other liquid within the pipe in the majority of cases and, furthermore, will measure the actual depth of fluid if that depth is more than 2 in.

Also, the instruments and methods were found useful in checking for solids which accumulate upstream of orifice plates. At one meter run, tests revealed the presence of 2½ in. of solid material which had collected upstream from the plate.

The tests indicated that for the particular pipelines tested, the previously held concept of liquids collecting in deep pools within the lines is false. Instead, the liquid apparently extends as a shallow river for a long distance along the bottom of the pipe.

Preliminary tests . . . Before attempting to make measurements on an operating line, several check runs were made on short, horizontal lengths of 30-in. pipe which were filled to desired depths with liquid taken from pipeline drips. The liquid probably consisted of a mixture of lube oil, water, and sand. These runs were made to ascertain which of several possible techniques of ultrasonic testing would be most appropriate for field work, and also to calibrate test instruments against known depths of liquid.



ACTUAL OSCILLOSCOPE PATTERN observed when using the absorption method with no liquid present in the pipe.

As a result of the preliminary tests it was decided to use two methods in the field, namely, the "absorption" and the "penetration" methods. In both methods the crystal for transmitting and receiving the sound waves is placed on the bottom of the pipe. Also, both methods use pulse-type rather than continuous wave transmission and employ a single crystal as a combination transmitter and receiver, or transceiver.

In order to properly couple the crystal to the steel, a mixture of glycerin and Aersol, a chemical wetting agent, was used. Oil was found to be a poor

coupling medium. A small amount of the coupling liquid is applied to the pipe with a rag or brush and serves to exclude air between crystal and steel, lowering the acoustical impedance of the connection.

In the absorption method the transmitted wave is reflected back and forth several times from the steel-gas or steel-liquid interface to the coupling connection. The number of reflections depends on the presence or absence of liquid in contact with the inside pipe wall at the point of reflection.

The approximate equation generally applied in this work for the ratio of reflected acoustical energy to incident energy is as follows:[1]

$$E_r/E_i = \left(\frac{\rho_1 V_1 - \rho_2 V_2}{\rho_1 V_1 + \rho_2 V_2} \right)^2 \quad (1)$$

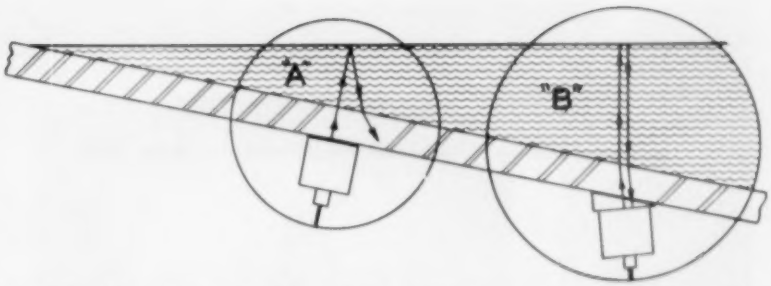
where:

ρ_1 = density of medium 1 (steel in this case)
ρ_2 = density of contained fluid (gas or liquid in this case)
V_1 = wave velocity in medium 1
V_2 = wave velocity in medium 2

It can be seen that with gas as the second medium the $\rho_2 V_2$ term becomes very small compared to the first term and the ratio approaches unity as a limit. This suggests an infinite number of reflections but, in practice, losses which are not accounted for in the equation cause the reflected energy to be attenuated in a relatively short period of time. For example, with normal gain offered by the electronic test instruments, the scope pattern when testing ⅜-in.-wall pipe with no liquid present reveals between 10 and 15 reflections, as shown in the accompanying photo. It will be noted that the amplitude of succeeding pulses is attenuated expotentially until the train is completely dampened.

However, with a layer of liquid present within the pipe, the $\rho_2 V_2$ term of Equation 1 becomes appreciable and a much larger amount of the ultrasonic energy is transmitted into the liquid medium, resulting in more rapid attenuation and a consequent reduction in the number of reflections. This reduction usually amounts to about 50 per cent. Hence, by moving the crystal around the circumference of the pipe, and noting the point of change in reflection pattern, the depth of liquid may be determined. Fig. 1 illustrates this technique.

Test frequencies of 2.25 and 5.0 megacycles were used with the absorption method with the latter frequency proving the most effective.



MEASURING DEPTH on an inclined line. In "A" the return wave will miss the crystal held perpendicular to the pipe. In "B" an adapter is used to project the wave normal to the liquid surface, causing the reflected wave to return to the crystal. Fig. 3.

Low-frequency method . . . In the penetration method, a comparatively low ultrasonic frequency of 1.0 mc. was used. The transmitted wave penetrates the pipe wall, the steel-liquid interface, reflects from the liquid-gas interface, and returns to the transceiver. Lateral displacement between the transmitted and echo pulse on the scope is a direct function of the time of travel and hence, of the thickness of the steel and liquid media. The oscilloscope was calibrated to read quantitatively by making test runs on a container with known depths of liquid and by adjusting marker pips on the scope trace so that each pip was equivalent to 1 in. of liquid. (See Fig. 2.)

A lower test frequency was used with this method to avoid the extreme attenuation suffered by the higher frequencies in the liquid medium. The variation of attenuation with frequency is evident from the following equation:[2]

$$A_r = \left(\frac{r}{f}\right)\left(\frac{2\pi I_0 \epsilon^{-\alpha r}}{R}\right)^{\frac{1}{2}} \quad \ldots (2)$$

where:

A_r = wave amplitude at distance r from source
f = frequency in cycles per second
I_0 = intensity at the source
α = medium absorption coefficient, which also increases as the square of the frequency
R = specific acoustical resistance of the material

Expressed in another manner:

$$A \cong \left(\epsilon^{-f^2}\right)\left(\frac{1}{f}\right) \cong \frac{1}{\left(\epsilon f^2\right)(f)} \quad \ldots (3)$$

Thus, from Equation 3, losses increase rapidly as the frequency increases, regardless of the medium. Therefore, if energy input is held constant, there is a definite upper limit of frequency for an incident wave to penetrate both media and return to the transceiver with sufficient power to give an indication on the scope. For example, a 2.25-mc. pulse was so severely attenuated that a reflection from the liquid-gas interface was not discernible, the scope pattern resembling that of the absorption method. Use of a 0.5-mc. wave was also attempted but this proved impractical because, inherently, longer wave lengths cannot be resolved as precisely by the receiving instrument and the result is a decrease in measurement accuracy.

Tests on operating lines . . . Seven locations on main lines of El Paso Natural were chosen for field tests. Five of the locations were in troughs where there was likelihood of liquid in appreciable quantities.

By using the absorption method it was determined that liquid was present in small quantities at five of the seven locations, and there were positive indications of the absence of liquid at the other two. The reflection pattern observed at locations with liquid seemed to show intermittent flow—i.e., covering and uncovering of the steel at a rate of 4 or 5 cycles per second. This, and the fact that at no place was liquid deep enough to be measured by the penetration method, leads to the conclusion that under turbulent-flow conditions the liquid travels in very shallow rivers along the bottom of the pipe. No sign of "slug" flow was found at any of the test points.

It was determined from field testing that for reliable results using the absorption method, the pipe surface at point of contact must be carefully cleaned to afford good coupling. A transceiver crystal curved to fit the pipe and the use of a magnetic holder to assure steady contact appear to be the answer to this problem.

Limitations . . . In the preliminary and field tests it was noted that the testing methods have certain definite limitations. The absorption method cannot be relied upon if a coating of loose corrosion product or a dry sand layer exists on the inside pipe wall to effectively separate the steel and liquid.

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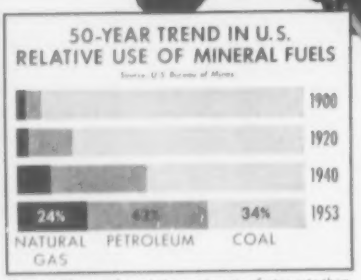

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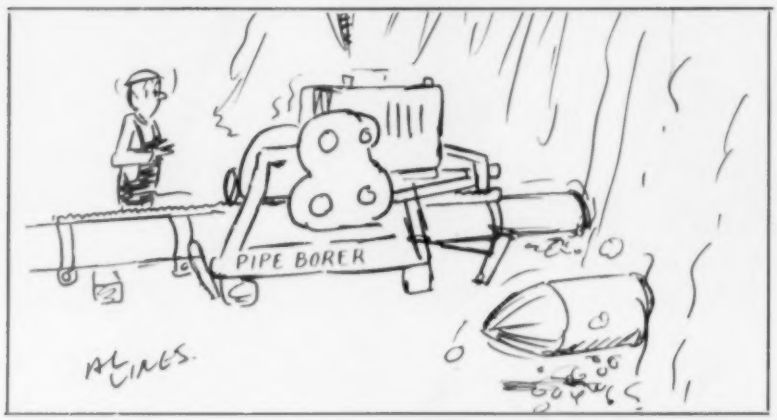

In this case the reflection pattern resembles that of a line with no liquid. Also, the presence of a layer of oil-saturated sand on the pipe wall above the liquid level will render impossible the measurement of actual depth since the reflection pattern will not show a sharp change.

The penetration method also has limitations besides that of being unable to measure depths less than 2 in. The surface of the liquid must be within 4° or 5° of being parallel to the pipe bottom or the return wave will not strike the transceiver crystal. This fact prevents measurements being made in sharp sags or on steeply inclined portions of the pipeline unless a special coupling arrangement is made to allow the transmitted wave to enter the liquid perpendicular to the liquid-gas interface. (See Fig. 3.)

High-frequency ripples on the liquid surface with a wave length and amplitude in the order of ¼ in. will make measurements by the penetration method indeterminate since the ripples cause too much dispersion of the reflected wave.

Also, as in the absorption method, measurements cannot be made effectively if the inside wall is lined with scale or dry sand. However, a saturated sand can be penetrated, and a measurement obtained.

Conclusions and Evaluations

1. In the great majority of cases the use of ultrasonic measuring techniques will provide the answer as to whether or not liquid is present in an operating gas pipeline. Only in borderline cases will actual tapping be necessary.

2. With proper recognition of the limitations listed above, the equipment and techniques will measure the actual depth of liquids in pools exceeding 2 in. deep.

3. Development of more suitable crystals and crystal holders is needed to assure more accurate measurements.

4. At the present state of the art, ultrasonic testing, used in conjunction with more conventional methods, will yield valuable information for the gas industry on the question of two-phase flow within pipelines.

The testing techniques mentioned above were developed by Dwight J. Evans of Engineering Test Services, Inc., Tulsa, and the tests were performed under the supervision of Glenn Damewood and Clint McClure, with El Paso Natural.

References

1. A.S.T.M. Special Technical Bulletin 101, "Symposium on Ultrasonic Testing," 1949.
2. Heiland, C. A., Geophysical Exploration, Prentice-Hall, pp. 477-481.

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Pipeline Patrol

. . . Report on Construction

King-size dynamite charge on gas line

THE H. C. Price Co. of Bartlesville, Okla., rocked the Kanawha River bottom near Charleston, W. Va., recently when its engineers set off fifty 950-lb. blocks of 80 per cent high-velocity dynamite. Price men believe that this was the largest amount of dynamite ever used for a "string shot." Besides blasting a ditch for the 30-in. pipe Price was laying for United Fuel Gas Co., the vibrations after the shock probably stunned every fish in the vicinity.

Underway, Contracted, and Planned

PIPELINE activity as reported below by The Oil and Gas Journal is compiled from information received from pipeline companies and contracting firms.

These projects include those planned, proposed, under way, and contracted. Uncontracted projects are indicated by a • preceding the job.

Crude-Oil Pipelines

Arapahoe Pipe Line Co.—This company owned jointly by Sinclair and Pure has let contracts on a 494-mile crude line from Merino, Colo., to Humboldt, Kans. The contracts were let in the following sections:

Section 1.—149 miles of 18-in. from Merino to Colby, Kans., R. H. Fulton & Co.

Section 2.—162 miles of 18-in. from Colby to Schurr Station, Kans., R. H. Fulton.

Section 3.—84 miles of 20-in. from Schurr Station to Burns, Kans., R. H. Fulton.

Section 4.—86 miles of 20-in. from Burns to Humboldt, Panama Williams Co.

Ar-Mex Pipe Line Co.—Company has applications for two lines before the Office of Defense Mobilization Board for rapid amortization approval.

1. A crude-oil line from Albuquerque, N. M., to Phoenix, Ariz. This line would serve a 20,000-bbl. refinery being planned by Frost & Associates of Dallas.

2. A crude-oil line from Guernsey, Wyo., to Albuquerque.

• **California-Oregon Pipe Line System.**—103 miles 6-in., proposed, Crescent City, Calif., to Medford, Ore.

Magnolia Petroleum Co.—This company and two other interested parties plan a 46-

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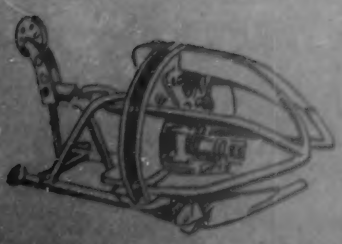
GENERAL PIPE LINE CONSTRUCTION



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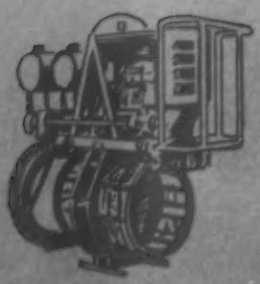

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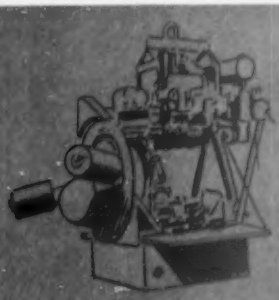

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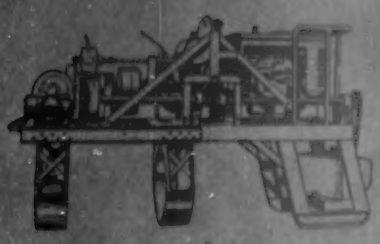

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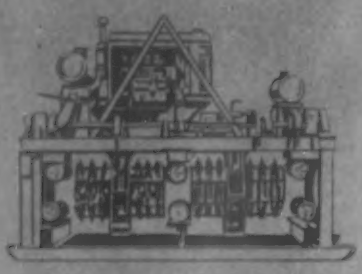

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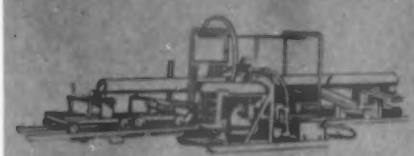

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Pipeline Patrol

mile, 12¾-in. crude line from Atchafalya Bay to production platforms off the Louisiana coast. Eventual capacity of the line would be 30,000 bbl. daily.

Minnesota Pipe Line Co.—Williams Brothers Co. has contract to build this 260-mile, 16-in. crude line from Clearbrook to Hastings, Minn. The line, to cost $12,500,000, is the southern end of a system which will move crude from Fosterton field, Sask., to Great Northern's refinery which is building in the Minneapolis-St. Paul area. Present plans call for completion by July 1955.

• **NNCW Pipeline Co.**—127-mile line, proposed, from Weston County, Wyoming, to Casper. 108 miles of 10-in. and 19 miles of 8-in. Est. cost: $3,500,000.

Shell Pipe Line Corp.—Houston Contracting Co. has contract to build 72 miles of 8-in. line from Halletsville to Brookshire, Tex. Job includes crossings of Brazos and Colorado rivers. H. J. Muckley is superintendent, H. L. Leake is spread superintendent. Completed September 10.

Standard Pipe Line Co.—Company plans to build two crude lines. Applications are now before the Office of Defense Mobilization for rapid amortization approval.

1. A 350-mile, 16-in. crude line from Glendive, Mont., to Guernsey, Wyo., to connect with Platte Pipe Line Co.'s system there.

2. A 330-mile, 16-in. crude line from Wink, Tex., to Albuquerque, N. M. This line would serve a 10,000-bbl. refinery being planned by Frost & Associates of Dallas.

Trans Mountain Oil Pipe Line Co.—Company has awarded contract to Engineers Limited Pipeline Co. to build 15 miles of 20-in. and 11 miles of 16-in. line. Both lines run from Sumas, B. C., to General Petroleum's refinery which is being built at Ferndale, Wash. Completion set for September 1954.

• **Union Oil Co. of California.**—Planning construction of a 60-mile crude line from its Clara Valley field to its Wilmington refinery. Line is expected to be completed by late this year. Size not yet determined. Engineering work under way.

Western Pipe Line Co.—This subsidiary of Service Pipe Line Co. has let contracts for 630 miles of 20, 22, and 24-in. crude line from Fort Laramie, Wyo., to Freeman, Mo. The western section of the line will be laid by H. B. Zachry Co. and the eastern section will be constructed by O. R. Burden Construction Corp. Completion set for December 1.

Products Pipelines

• **American Pipe Line Co.**—Has received ODM approval to amortize 40 per cent of $178,000,000 with a rapid writeoff on proposed line to run from Gulf Coast area to New York City area. Bids for pipe requested.

Badger Pipe Line Co.—Company to build 195 miles of 8-10-12-in. pipeline from East Chicago, Ind., to Madison, Wis. One section of 40 miles has been let to Morrison Construction Co. of Hammond, Ind.

• **H. W. Bass & Sons, Inc.**—152 miles, 4-6-in., proposed. Duval and Live Oak counties, Texas, to Corpus Christi, Tex.

Great Lakes Pipe Line Co.—Company has finished a 714-mile expansion program which it began the first of Spring. The first section of the program was a 182-mile, 8-in. line from Nebraska City to Doniphan, Neb. The remainder of the work was divided as follows:

127 miles, 8-in. from Iowa City, Iowa, to Prophetstown, Ill., to tie in with the Badger system there. M. R. Co. and Mid-States Construction Co. had the job.

188 miles of 12-in. from Kansas City to

LOOKING AHEAD . . . puts the skids on pipeline problems

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Pipeline Patrol

Des Moines. Midwestern Constructors, Inc., had 48 miles, R. H. Fulton & Co. 71 miles, and M. R. Co. had 69 miles.

83 miles of 12-in. between Alexandria and Rosendale, Minn., was done by Associated Pipe Line Contractors, Inc.

80 miles of 12-in. between Rosendale and Rosemount, Minn., was done by R. H. Fulton & Co.

105 miles of 8-in. from Alexandria to Fargo, N. D., was done by R. H. Fulton & Co.

Harbor Products System.—86 miles of 16-in. under way from Woodbury Junction to Tremley Point, N. J. Pipeline Construction & Drilling Co. is doing the work and completion is not definite because of right-of-way difficulties. Completed September 8.

• **International Pipe Line, Inc.**—132 miles 8-in., proposed, Wrenshall to Minneapolis, Minn. Cost: $4,200,000.

Moore Stoner Co.—Company has $2,500,000 tax amortization for a 200-mile, 6-in. products line from a connection with Oil Basin Pipe Line Co.'s terminal at Glendive, Mont., to Minot, N. D.

Oil Basin Pipe Line Co.—Midwestern Constructors, Inc., doing the work on this 230 miles of 8-in. products line from Laurel to Glendive, Mont. Tentative completion date set for October 1. Cost: $5,350,000.

Phillips Petroleum Co.—Company has let 72 miles of 8-in. line to Somerville Construction Co. of Ada, Mich. Work being done between East St. Louis and Kankakee, Ill. Work to be completed by October 15.

Shell Pipe Line Corp.—65 miles of 12-in. products line from Baton Rouge, La., to Shell's Norco refinery. Houston Contracting Co. has contract. H. T. Muckley, Supt. Job held up indefinitely by right-of-way difficulties.

Standard Oil Co. of Texas.—Company taking bids for the laying of a 248-mile, 6-in. products line from El Paso to Albuquerque. Construction is expected to get under way by October 1. The line will move 5,000-bbl. daily when finished and will cost $4,000,000.

• **Sunflower Pipe Line System.**—Company proposes to build a 215-mile, 6-in. line to transport LPG from six counties in western Kansas to Wichita. Application approved by Kansas Corporation Commission.

Texas Eastern Transmission Corp.—Company has asked FPC permission to abandon "Little Inch" gas line. If permission is granted, company will spend $71,000,000 converting the line to a products line with a capacity of 235,000-bbl. per day.

U. S. Gov't. Alaskan Products Pipe Line.—600 miles of 8-in. under way from Haines northward through Yukon to Fairbanks, Alaska. Williams Bros., McLaughlin, Inc., and Marwell Construction Co. are doing the work. Pipe laying will be through by November of 1954; however, entire job not expected to be completed until September of 1955.

Wyoming-Nebraska Pipeline Co.—Houston Contracting Co. has general contract to build 220 miles of 6-in. line from Frontier Oil Co.'s refinery at Cheyenne to North Platte, Nebr. Work expected to be completed by October 1954.

Natural-Gas Pipelines

• **American-Louisiana Pipe Line Co.**—1,121 miles of 30 and 22-in., 30-in., proposed, extends from North Tepetate, Acadia Parish, Louisiana, to near Detroit. The 22-in. starts

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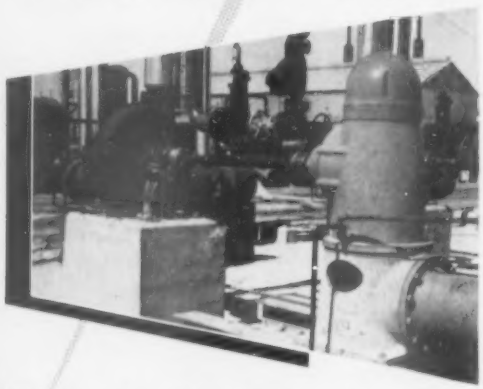

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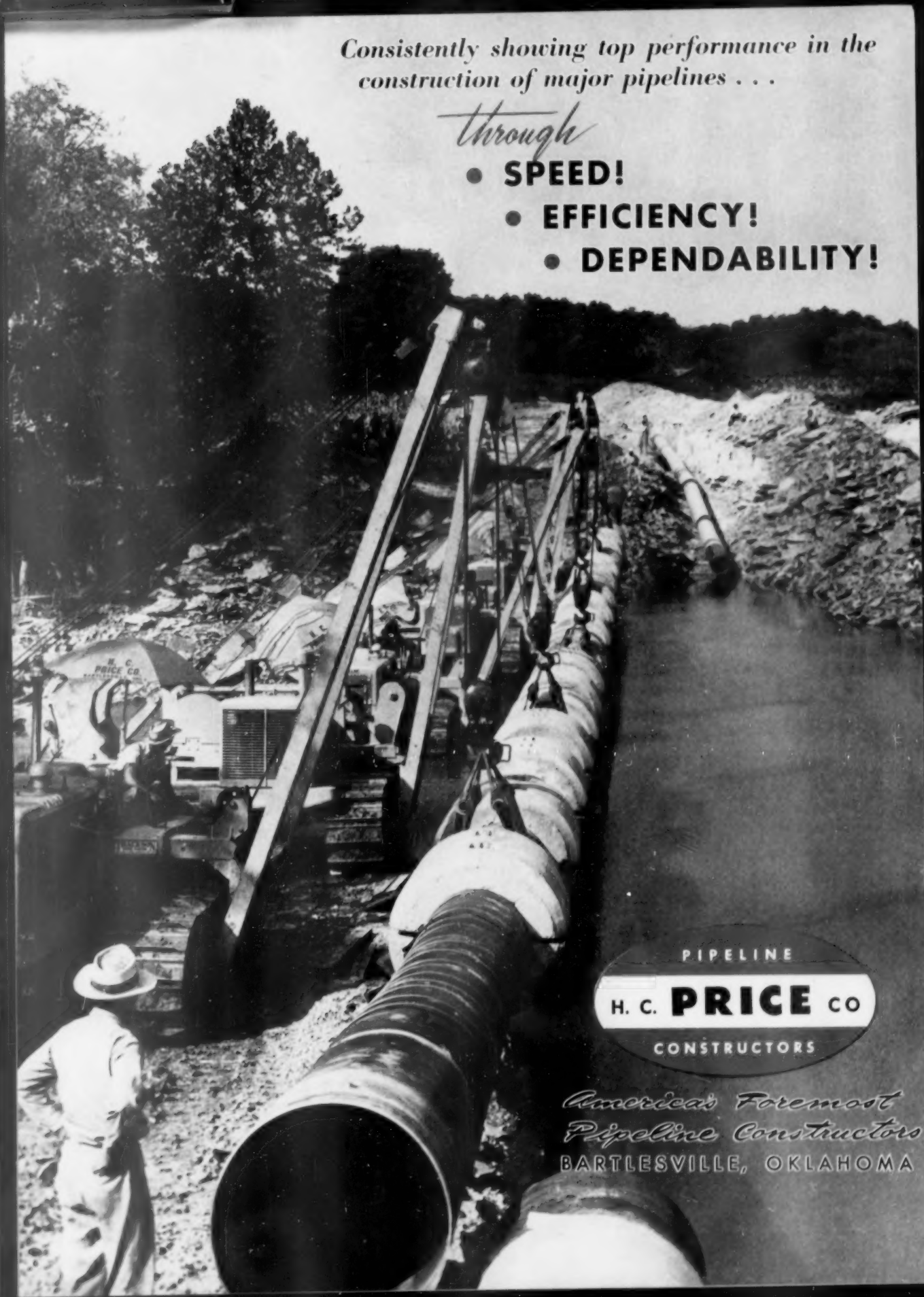
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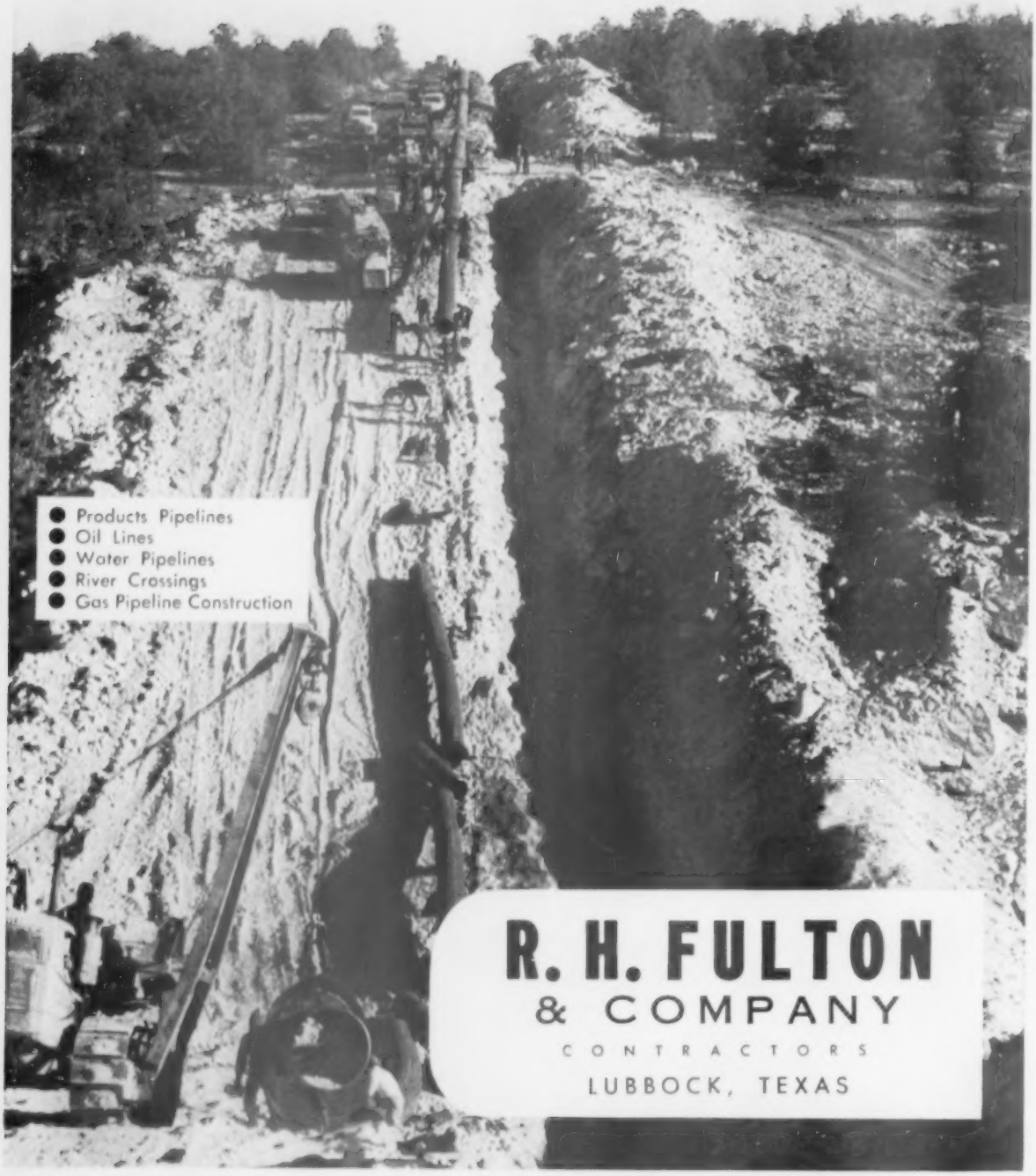

R. H. FULTON
& COMPANY
CONTRACTORS
LUBBOCK, TEXAS

Pipeline Patrol

near Payne, Ohio, extends to Bridgman, Mich. Estimated cost: $130,000,000.

• **Arkansas Louisiana Gas Co.**—136 miles of new line proposed, to be added to present system in Arkansas, Louisiana, and Texas. Estimated cost: $9,245,166. FPC approved.

• **Carolina Natural Gas Corp.**—185 miles, 2-12-in., proposed, later lines off Transcontinental in North and South Carolina.

• **Central Hudson Gas & Electric Corp.**—Company has filed application with FPC to construct 48 miles of 12-in. line from Albany to Kingston, N. Y. Line will be started and completed in 1955 if FPC approves.

Chicago District Pipe Line Co.—19 miles of 36 and 30-in., completed of 35 miles planned. Remainder, all 30-in., will be completed in 1954.

• **Cities Service Gas Co.**—24 miles of 26-in., planned, to replace two existing 16-in. lines in Franklin and Johnson counties, Kansas. F.P.C. approved.

Nine miles of 20-in. to replace existing 16-in. line in Cherokee and Jasper counties, Missouri. F.P.C. approved.

• **City of Dalton, Ga.**—Proposes to build 39 miles of 8-in. from a point of interconnection with Southern Natural's Rome-Calhoun transmission line. Estimated cost: $2,940,000.

• **City of Fayette, Ala.**—20 miles, 5-in., F.P.C. approved, Fayette, Ala., to Southern Natural's system in Tuscaloosa County, Alabama. Completion set for early 1955.

• **Colorado Interstate Gas Co.**—365 miles, 22-in., approved by F.P.C., Green River, Wyo., to Denver, Colo., 1954.

• **Colorado-Western Pipe Line Co.**—454 miles of undetermined size pipe planned between Cortez in Montezuma County and Denver. Line would serve towns of Montrose, Gunnison, Salida, Fairplay and South Platte, Colo. Estimated cost: $30,000,000. Company also plans 254 miles of laterals to service Colorado cities not now receiving natural gas.

328-mile line, proposed, to run from a point in La Plata County in southwestern Colorado over the Continental Divide along the eastern slope to serve Pueblo, Colorado Springs, and Denver. Estimated cost: $21,600,000.

• **Fort Worth Basin Gas Co.**—Planned, Novice, through Brown and Comanche counties, Texas.

Gulf Interstate Gas Co.—Company is winding up 860-mile, 30-in. job from Acadia Parish, Louisiana, to Boyd County, Kentucky.

• **Home Gas Co.**—Work under way on 24 miles of 12-in. from Halsey Valley to Westover, N. Y.

Work under way on 25 miles of 12-in. from Port Dickinson to Deposit, N. Y.

• **Hope Natural Gas Co.**—Proposing to build a 22½-mile extension of existing line from Boone County, West Virginia, to Logan-Mingo County line, West Virginia. Estimated cost: $930,000.

• **Houston Texas Gas & Oil Co.**—Company proposes to build three natural gas lines. One line would run from lower Rio Grande Valley to Chicago. The other line would go from southern Louisiana to New York City. Third line would run from Louisiana to Florida., 20, 24, 30-in., pipe considered in plans. Engineering firm reported preparing an economic report on the lines at present.

• **Iroquois Gas Corp. and Tennessee Gas Transmission Co.**—Companies planning joint storage project to be known as Colden storage field in New York. The following delivery and gathering lines are planned:

17 miles, 16-in. delivery line.

62 miles, 12, 8, 6, and 4-in. gathering lines.

• **Iroquois Gas Corp.**—25 miles of 20-in. line, approved by FPC, from Iroquois' Porter-

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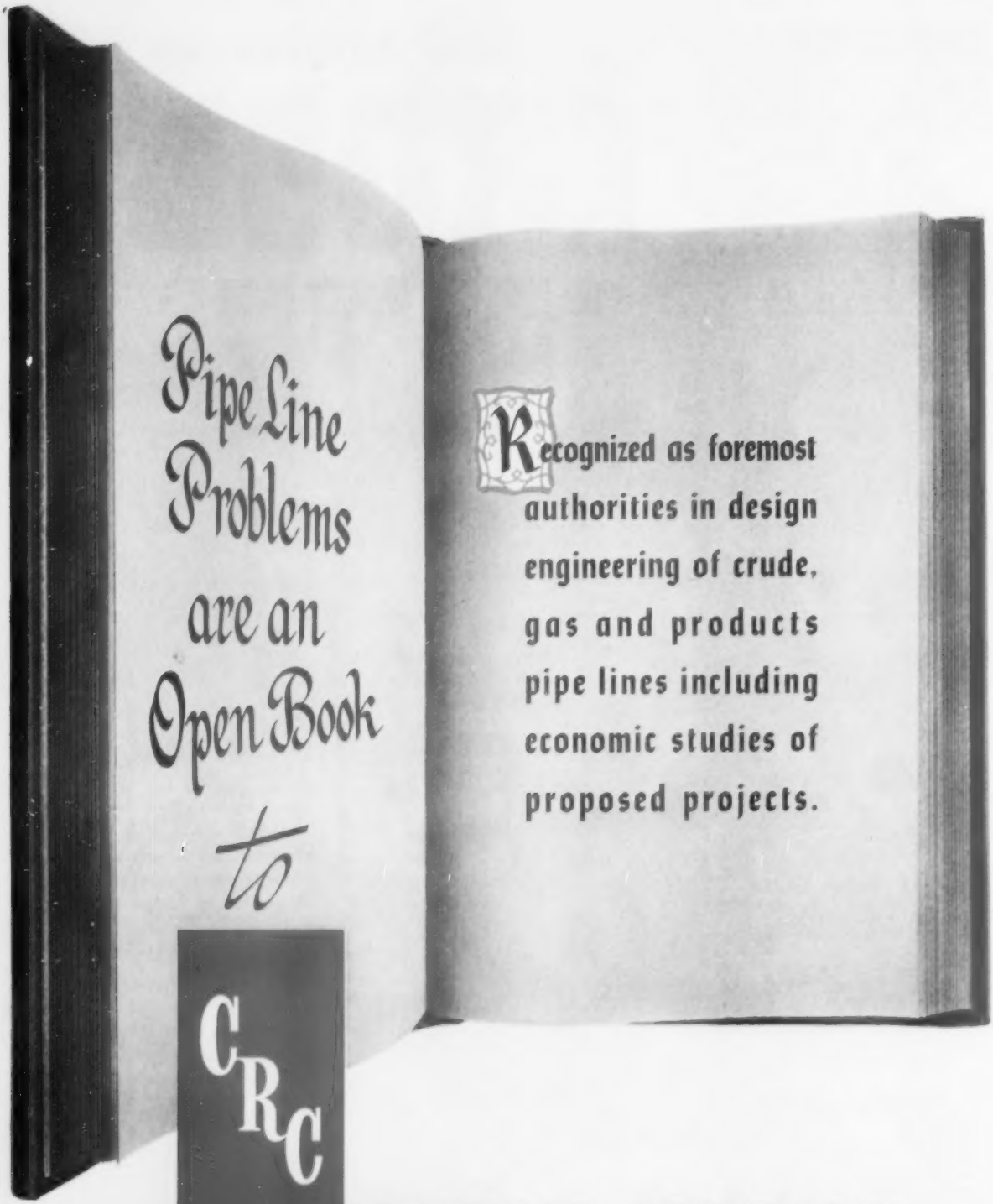

CRC

ENGINEERING COMPANY

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HOUSTON, TEXAS

Pipeline Patrol

ville station near Elma, N. Y., to Tonawanda, N. Y. Est. cost: $1,540,000.

• **Kansas-Nebraska Natural Gas Co., Inc.** Proposes to construct 206 miles of 6-12-in. pipeline to add to present system in central and northeastern Nebraska.

• **Manufacturers Gas Light & Heat Co.**—40 miles, proposed, Allegheny, Washington and Beaver counties, Pennsylvania.

213 miles, 3 to 26-in., proposed, various points on system in Pennsylvania, West Virginia, and Ohio.

72 miles, 16-20-in., Doddridge, Wetzel and Marshall counties, West Virginia. Fulghum Contracting Co. doing work.

• **Michigan Consolidated Gas Co.**—25 miles, 12-in., proposed, from near Sparta to Muskegon, Mich.

• **Michigan Wisconsin Pipe Line Co.**—251 miles, proposed, 24, 18, 12, 6, and 4-in. loops. Majority will be in Wisconsin.

Mid-South Gas Co.—Engineering Construction Co. of Tulsa has contract for 50 miles of various size pipe from Marion to Truman, Ark.

• **Missouri Central Gas Co.**—25 miles, 6-in., proposed, Moberly to Macon, Mo.

• **Missouri Public Service Co.**—136 miles, 8-10-in., proposed, New Franklin to Trenton, Mo.

24 miles, 10-in., Johnson County to Clinton, Mo. FPC approved. Est. cost: $600,000.

• **Montana-Dakota Utilities Co.**—Proposes to build 56 miles of 2, 4, and 6-in. line from its 12-in. Cabin Creek-Bismarck line near Gladstone, N. D., to the towns of Lefor, Regent, New England, and Mott, N. D.

• Proposed 34½ miles of 12¾-in. line to run from Baker-Glendive field in Montana to Rapid City, S. D., and 14 miles of 12¾-in. to replace various lines in Park County, Wyoming, and Carbon County, Montana.

• **Natural Gas Producer, Inc.**—100 miles, 12-in., planned, Yenter pool to Denver, Colo.

• **New River Gas Co.**—50 miles, planned, Summers to Monroe counties, West Virgina, to Narrows and Dublin, W. Va.

• **North Dakota Gas Transmission Co.**—470-mile line from Tioga plant of Signal Oil & Gas Co., and Beaver Lodge field to Fargo and Grand Forks, N. D. Line will have 78 miles of 12-in., 215 miles of 10-in., 70 miles of 8-in., and 107 miles of 6-in. Estimated cost: $10,800,000.

• **Northern Indiana Fuel & Light Co.**—35 miles, 8-in., planned, Edgerton to Auburn, Ind.

Northern Natural Gas Co.—Midwestern Constructors has finished one job for this company consisting of 5 loops of 94.3 miles of 30-in. line in Texas, Oklahoma, and Kansas.

93½ miles of 20-in. from Ogden to Waterloo, Iowa, being done by Hallmac Construction Co. of Houston.

90 miles of 16-in. from Waterloo to Dubuque, Iowa, being done by Engineering Construction Co. of Tulsa.

54 miles of 16 and 10-in. from Newton to Grinnell, Iowa, has been finished by G. G. Griffis Const. Co. of Tulsa.

24 and 26-in. lines south of Paullina, Iowa, and 20 and 24-in. lines from Paullina to Sioux City being done by R. H. Fulton Co.

Two underwater crossings totalling 5,100 ft. being done by Lone Star Constructors of Dallas.

G. G. Griffis also has 118 miles of 2-12-in. between Rochester and Redwing, Minn., for Northern Natural.

Completion dates not fully determined.

• **Northwest Alabama Gas District.**—40 miles, 9-in., proposed, Southern Natural's line through Winfield to Haleyville, Ala.

• **Ohio Fuel Gas Co.**—31 miles, 20-in., planned, Licking County to Richland County, Ohio.

22 miles, 16-in., planned, Dayton, Troy, Piqua, and Sidney, Ohio.

23 miles, 16-20-in., planned, Wellington to Elyria, Ohio; 16 miles, 20-in., planned, Benton Station to Crawford Station; 18 miles, 20-in., Crawford Station to near Columbus; 16 miles, 16-in., planned, Berlin to Sandusky, Ohio.

74 miles, 3 to 20-in., planned, Hocking, Knox., and Ashland counties, Ohio.

47 miles, 20-in., planned, Benton Township, Hocking County, to Columbus, Ohio.

61 miles, planned, northern and southwestern Ohio.

33 miles, 20-in., proposed, Jefferson to Seneca, Ohio.

69 miles, 20-24-in., proposed, lines to tiein Gulf Interstate line along various points in Lawrence, Jackson, Vinton, Hocking, and Fairfield counties, Ohio.

Pacific Gas & Electric Co.—200 miles, 34-in,. planned, paralleling Topock-Milpitas lines. 93 miles completed. 107 miles contracted to Engineers Limited Pipe Line Co. L. E. Robertson is in charge of the spread handling work from Newberry to Danby and from Los Muertos Creek to Gilroy, Calif. Completion November 1954.

15 miles, 20-in., planned for completion in 1955 from Helm Tap to Helm Junction, Calif. Alex Robertson Co.

15 miles, 12-in., planned for completion in 1955. From Herndon to Madera, Calif. Company forces.

• **Pacific Northwest Pipeline Corp.**—1,466 miles, proposed, Ignacio, Colo., to Bellingham, Wash. Approved by FPC.

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380 miles, proposed, laterals and spurs off main line to Pocatello, Idaho, to Yakima, Wash.

Panhandle Eastern Pipe Line Co.—FPC has given this company a temporary certificate to construct 295 miles of 30-in. looping to get additional gas to companies in Illinois, Indiana, Michigan, Ohio, and Missouri before cold weather. The job is costing $22,885,000 and is part of a $66,750,000 expansion program. The remainder of the program calls for $23,580,000 for new compressors and the leaching out of an underground storage cavity near Waverly, Ill., and $11,427,500 for production and gathering facilities improvements in the field.

• **Pine Tree Natural Gas Co.**—204 miles of undetermined size pipe to run from the Boston area to Bangor, Me.

• **Shenandoah Gas Co.**—40 miles, 3-4-8-in., proposed, Middleton, Va., to Martinsburg, W. Va. Est. cost: $1,470,000. FPC approved.

• **South Georgia Natural Gas Co.**—368 miles, 2-12-in., planned, Phoenix, Ala., to Tallahassee, Fla. (a) 12-in., Phoenix, Ala., to Albany, Ga., (b) 10-in., Albany, Ga., to Moultrie, Ga., (c) 8-in., Moultrie, Ga., to Tallahassee. Est. cost: $9,000,000. FPC approved.

• **Southwest Alabama Gas District.**—150 miles, 10 and 8-in., planned, Phoenix City to Dothan, Ala. Engineering Const. Co.

Tennessee Gas Transmission Co.—Company has awarded following contracts on 5.66.8 miles of 30-in. line from Kinder, La., to Portland, Tenn.

98.7 miles from Kinder to U. S. Highway 84 near Jena, La., to Morrison Constructors, Inc.

90.2 miles from U. S. Highway 84 to Louisiana side of Mississippi River to Anderson Brothers Corp.

105 miles from Mississippi River to U. S. Highway 51 near Grenada, Miss., to Houston Contracting Co.

101.6 miles from Grenada to U. S. Highway 45 near Corinth, Miss., to Oklahoma Pipe Line Constructors.

94.9 miles from U. S. Highway 45 to near Centerville, Tenn., to Western Pipe Line Constructors, Inc.

75.6 miles from Centerville to near Portland, Tenn., to Panama-Williams Co.

63 miles, 26-in., under way, loops in Ohio and Pennsylvania. H. C. Price Co.

45 miles, 20-in., proposed, Buffalo, N. Y., to the U. S.-Canadian border near St. Catherines.

243 miles 24-in., planned, Coudersport, Pa., eastward across Pennnsylvania, New Jersey, and New York to point near Greenwich, Conn.

• **Texas Eastern Transmission Corp.**—Proposed 382-mile, 30-in. line from Kosciusko, Miss. to Beaumont, to connect with the existing 30-in. line there to Connellsville and replace the "Little Inch" in moving natural gas.

• Company proposes to build 58 miles of 20 and 16-in. pipeline from Joaquin to Longview, Tex. Company has filed an application with the Federal Power Commission. Cost: $3,269,000.

Texas Eastern Penn-Jersey Transmission Corp.—265 miles, 24-in., approved by the FPC from Oakford Storage field in western Pennsylvania to Texas Eastern Transmission Corp.'s Compressor Station No. 26 near Lambertville, N. J. Est. cost: $30,755,000. 54 miles let to H. C. Price Co. C. E. Shivel, superintendent.

• **Texas Gas Transmission Corp.**—48 miles, 26-in., planned, loops from Memphis to Slaughters, Ky.

24 miles, 16-in. line planned from North

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Pipeline Patrol

Tepetate field, Acadia Parish, Louisiana, to South Roanoke field in Jefferson Davis Parish, Louisiana. Work to be done in September and October by Houston Contracting.

• **Transcontinental Gas Pipe Line Corp.**—421 miles, 30-36-in., looping along Texas-New York line.

• 19 miles of 12.75-in. pipe starting at West White Lake field in Vermilion Parish, Louisiana, and connecting with applicant's transmission line in same parish. Estimated cost: $1,042,310. FPC approval received.

• 57 miles of 36 and 30-in. paralleling sections of its existing system in Louisiana, Mississippi, and Alabama. Approved by FPC. Est. cost: $6,533,000.

• 25 miles of 12-in. in Cameron and Calcasieu parishes, Louisiana, to additional gas reserves. Est. cost: $1,000,000.

• **Trunkline Gas Co.**—Proposes to cross the Mississippi River with two 24-in. lines near Greenville, Miss. Est. cost: $2,960,000.

• **Utah Natural Gas Co.**—Planning 40 miles from Orem to Salt Lake City, 16-in. pipe at later date. Contract not let yet.

Virginia Natural Gas Co.—153 miles, Buckingham to Richmond and Portsmouth, Va.

Foreign Crude-Oil Pipelines

• **Atlas-Dresser.**—Included in this company's agreement with the Argentine Government are plans to built a 400-mile, 16-in. crude line from Plaza Huincul area to Bahia Blanca.

Bombay Port Trust.—50 miles, 8 to 24-in., contracted, Bombay, India, to serve Standard Vacuum Oil Co., and Burmah Shell refineries. Merritt, Chapman & Scott Corp., contractors. (Crude and Products). Collins Const. Co. has subbed 84,000 ft. of Sabaqueous work. Shutdown for Monsoon season during summer. Work resumed September 15.

Interprovincial Pipe Line Co. and Lakehead Pipe Line Co.—Contracts have been awarded for 604 miles of looping; 454 miles will be in Canada, the remaining 150 miles will be in the United States.

201 miles of 24-in. between Regina and Gretna, Man., have been awarded to Anderson International Contractors, Ltd., of Edmonton, Alta.

Mannix, Ltd., of Calgary, Alta., will lay 129 miles of 24-in. line between Edmonton and the Alberta-Saskatchewan boundary.

Fulton-Bannister, Ltd., has contract for 125 miles of 24-in. line to connect the lines being built by Anderson and Mannix.

R. H. Fulton & Co., of Lubbock, Tex., has the contract for 104 miles of 26-in. looping from the Canadian border southeast. Anderson Bros. Corp. has contract for 50 miles of 26-in.

South Saskatchewan Pipe Lines, Ltd.—Fulton-Banister, Ltd. has contract to construct 150 miles of 16-in. crude line from Fosterton field in Saskatchewan to a connection with Interprovincial Pipe Line Co.'s system at Regina. Line will have a capacity of 20,000-bbl. per day, will cost $10,000,000 and is expected to be finished by November.

• **Pembina Pipe Line Co., Ltd.**—Company building 325 miles of 3-12-in. gathering line from Pembina field and a 72-mile, 16-in. transmission line to the terminals of Trans Mountain Pipe Line Co., and Interprovincial Pipe Line Co. at Edmonton, Alta.

• **Petroleos Mexicanos.**—145 miles, 12-in., considered, 18 de Marzo field via Reynosa to Monterrey, Mexico.

100 miles, planned, Isthmus of Tehuantepec, Jose Colomo to El Plan field, Minatitlan.

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Pipeline Patrol

72 miles, 12-in., proposed, Poza Rica to Atzacapotzalco, Mexico.

• **Petroleos Mexicanos.**—145 miles, 12-in., under way, Jose Colomo to El Plan, Mexico.

Texas Petroleum Co.—Contract has been let to Foster Wheeler Corp. and Panama-Williams for a 119-mile 12-in. crude line to move oil from Velasquez field in Colombia to a connection with the main Andian National system at Galan. Est. cost: $6,000,000.

• **Yacimientos Petroliferos Fiscales Bolivianos.**—170 miles, 4-in., planned, Bermejo to Tupiza, Bolivia.

Foreign Products Pipelines

Anglo-Iranian Oil Co., Ltd.—18½ miles 16-in., under way, Little Aden to Aden. Bechtel Corp. Completion date December 1954.

18½ miles, 6-in., under way, Little Aden to Aden,. Bechtel Corp. Completion date December 1954.

15 miles, 12-in., under way, Kwinana to Fremantle, M. W. Kellogg Co. Completion date February 1955.

17 miles, 6-in., Kwinana to Fremantle. M. W. Kellogg Co. Completion date February 1955.

• **Empresa Nacional del Petroleo** — 80 miles, 6⅝-in., planned, Concon to Santiago, Chile.

• **Governments of Southern Rhodesia and Portuguese East Africa.**—200 miles, considered, Beria, Portuguese Mozambique to Umtalia, Southern Rhodesia.

North Atlantic Treaty Organization (NATO).—1,920 miles, 4-10-in., to serve military bases in Western Europe (to connect with U. S. Government's St. Nazaire-Paris-Metz line). Contracted by Soc. Foster Wheeler Francaise.

• **Petroleos Mexicanos.**—124 miles, 6-in., planned, Lagos to Guadalajara, Mexico.

54 miles, 6-in., planned, Lagos to Aguascalientes, Mexico.

82 miles, 8-in., planned, Salamanca to Lagos, Mexico.

• **United States Government.**—375 miles, 12-in., planned, St. Nazaire to Melun and Metz, France.

• **United States Navy Department.**—Proposed 300-500-mile line to be built in Spain to serve a proposed naval base and four large air bases which are also proposed under a defense agreement with the Spanish Government. No definite size or cost is known now.

Foreign Natural-Gas Pipelines

Alberta Gas Trunk Line, Ltd.—This Canadian firm has let engineering c ontracts to two firms, Dutton, Williams Brothers, Ltd., and Mannix, Ltd. for a 300-mile, big inch gas-gathering system to collect Alberta's natural gas for transportation to Trans Canada Pipe Line Co.

Azienda Generale Italiana Petroli — 90 miles, 12-in., under way, Cortemaggiore to Bologna, Italy, SNAM crews.

120 miles, 16-in., under way, Cremona Porto Mar to Ghera, Italy, Montubi, contractor.

40 miles, 12-in., under way, Ripalta-Bergamo, Italy.

• **Empresa Nacional del Petroleo** — 80 miles, 10-in., planned, Concon to Santiago, Chile.

Petroleos Mexicanos. — 205 miles, 16-in., under way, Monterrey to Torreon, Mexico.

• **Petroleos Mexicanos.**—440 miles, 20-in., planned, Brazil to Tampico to Poza Rica, Mexico.

Sui Gas Transmission Co., Ltd.—Morrison-Knudsen Construction Co. has contract to build 350-mile, 16-in. line from Sui field to

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Pipeline Patrol

Karachi in West Pakistan. Est. cost: $25,000,000.

• **Trans-Canada Pipe Lines, Ltd., Canadian Delhi Oil Co.)**—2,247 miles, 14 to 30-in., proposed, Alberta to Toronto to Montreal. 747 miles, 8 to 24-in., gathering system in Alberta.

• **Union Gas Co. of Canada, Ltd.**—Proposed line from Lambton County gas-storage fields to Oakville. Line is being proposed now and will eventually join with proposed line from Alberta to Toronto and Montreal.

• **U. S. Navy.**—Proposes to build gas line from Gubik gas field near Navy Petroleum Reserve No. 4 in Alaska to Fairbanks. Line would be 450-mile, 8-in. line and Arctic Contractor, Inc., who handled engineering requirements and preliminary design estimated the line would cost $20,000,000, although later figures have been much higher than this.

• **Western Pipe Lines, Ltd.**—Will build 80-mile, 20-in. line from Niagara Falls, N. Y., to Toronto. Gas will be furnished by Tennessee Gas Transmission and taken over in Toronto by Consumers Gas Co. Est. cost: $7,000,000. Canadian Bechtel, Ltd., doing engineering work.

BOOKS

A.S.T.M. SPECIFICATIONS FOR STEEL PIPING MATERIALS. Prepared by A.S.T.M. Committee A-1 on Steel. Published by American Society for Testing Materials, 1916 Race Street, Philadelphia. 370 pp., $3.75.

This 1954 edition contains the A.S.T.M.'s specifications for carbon and alloy-steel pipe and tubing, including stainless. Of the specifications for carbon and alloy-steel pipe and tubing, including stainless. Of the specifications included in the previous issue, 22 have been revised for this edition—17 tentatives and 5 standards. In addition, a new specification is introduced to cover ferritic alloy-steel forged and bored pipe for high-temperature service.

CORROSION DATA SURVEY, 1954 EDITION. Compiled by G. A. Nelson. Published by Shell Development Co., Emeryville, Calif. Some 80 pp. including 66 foldout charts, $35.

Those responsible for choosing the metals to be used in equipment will find this compilation of corrosion data most helpful. It is presented almost entirely in chart form on foldout sheets that give corrosion rates for various metals in contact with different materials. Source material was culled from the literature and correlated into charts that make it simple to choose feasible metals for various uses.

LECTURES ON OIL AND GAS. Edited by Marlin M. Volz and Leo H. Whinery. Published by the Law Research and Extension Center, University of Kansas City School of Law, 5100 Rockhill Road, Kansas City, Mo. 203 pp., $5.

This publication consists of a series of 14 lectures on the basic aspects, both legal and nonlegal, of the oil and gas industry, which were delivered at Kansas City University's School of Law in the spring of 1953. Each lecture was presented by an expert in his field, and subjects covered included the entire range of petroleum-industry operating and marketing principles as well as the legal aspects of each industry phase. Both lawyers and persons interested in reviewing the fundamentals of petroleum production and marketing will find this publication a very helpful review.

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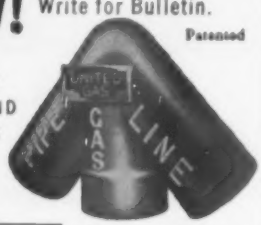

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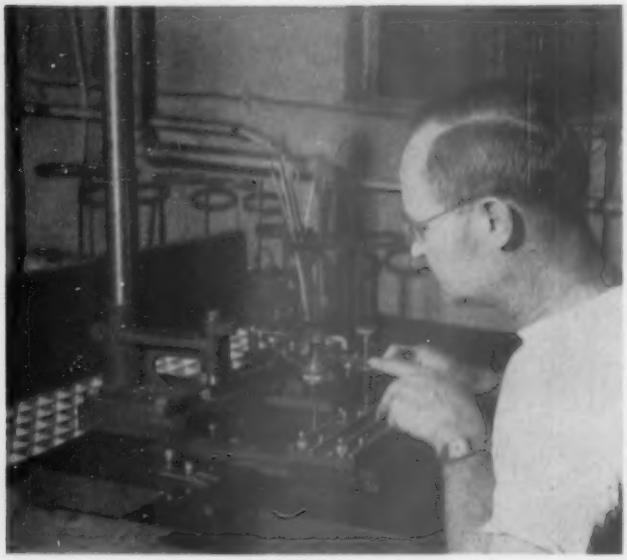
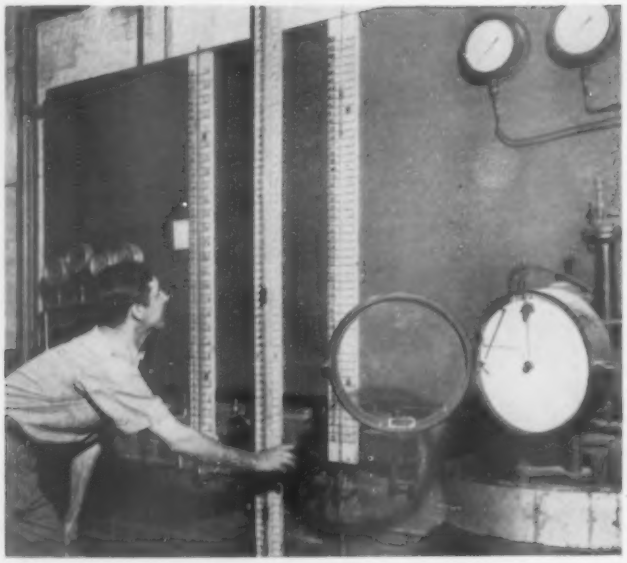


ALL INSTRUMENTS in the Whiting refinery are tagged with a permanent metal tag. Machine shown here is used to stamp identifying number on each tag. A file card is used to keep installation date and repair record.



SPECIALLY DESIGNED METER STANDS are used when cleaning differential-pressure-type meters, to avoid spilling mercury and other materials. The liquids are routed to settling tank below.

Keeping Them On Stream

It's mostly a matter of a well-conceived preventive-maintenance program

by W. A. Thiessen

AN outstanding feature of the instrument department at the Whiting refinery, Standard Oil Co. (Indiana), is the effective program of preventive maintenance which is carried out on a routine basis.

Maintenance procedures are carefully scheduled in uniform manner for areas throughout the refinery, thus making possible the interchange and transfer of men with a minimum of training or familiarization with the equipment.

Work sheets, made up for daily, weekly, monthly, and quarterly jobs, are issued weekly to the men in the plant. The work sheets are developed on a 4-week-to-the-month basis, with the fifth week included four times each year. All quarterly items are listed on the "fifth week" schedule.

Department scope . . . The Whiting refinery uses some 36,000 instruments, control valves, and other related devices. Keeping all these instruments and controls in proper operating condition is the job of the approximately 100 men who comprise the instrument department of the refinery.

Author is general foreman, instrument department, Whiting Refinery, Standard Oil Co. (Ind.).

The department consists of 11 supervisors, 80 instrument mechanics, and 14 apprentices. These men have as their responsibility approximately 8,500 instruments, 2,500 control valves, and over 25,000 indicating-pressure gages. All told, the group represents 1,500 different types of instruments, made by over 200 manufacturers.

In addition to keeping these devices operating, the instrument department keeps an eye on trends in refinery instrumentation, evaluates such trends and, if necessary, alters its organizational setup to obtain maximum benefit for all processing operations.

Department Organization

The instrument department at Whiting is part of the mechanical division, which includes the boiler, electric, pipe, machine, paint, welding, and other departments. To keep a large oil refinery operating efficiently requires extensive and orderly maintenance in which almost every type of tool and skill is required and utilized. That is why the mechanical division is made up of so many departments — each department specializing in certain fields.

To avoid duplication of effort and manpower, the instrument department calls upon the other maintenance departments to handle certain types of work for which they have the tools or are best qualified. Automatic control valves requiring shop repairs and machining are sent to the valve repair section in the machine shop.

Orifice plates are fabricated in the machine shop, as are thermometer and thermocouple protecting tubes. General piping required for instrument installations is handled by the pipe department. The electric department runs conduit, wires instrument panels, and performs all basic electrical work concerned with instrument installation. Refinishing of instrument cases, and other painting required in connection with instruments, is done by the paint department.

Work assignment . . . The instrument department has divided the refinery into four areas, with a foreman assigned to each area. The foreman in each area has 12 to 14 instrument mechanics and 1 or 2 apprentices under his supervision.

Each instrument mechanic is assigned one or more operating units, depending upon the size and number of instruments involved. Generally, the instrument mechanic is responsible for an average of 400 instruments and re-

lated pieces of equipment. His is the responsibility for the operation, repair, and all preventive maintenance of the instruments in the area to which he is assigned.

Part of the job of the instrument mechanic is to work very closely with operating personnel, assisting in placing instruments in service as the units are started up, and taking them out of service as the units are shut down.

During normal operation, instruments and control valves are inspected periodically on a routine schedule. During this period, the instrument man may discover an instrument which is not functioning properly and make repairs. He may also recommend modifications to existing instrumentation, such as adding a valve positioner to a control valve to improve operation.

It is, of course, necessary to service instruments on a 24-hour basis, and to accomplish this, a foreman and five instrument mechanics are assigned to each night shift. This same group maintains the equipment in the refinery on weekends and holidays. These men change a certain number of circular charts on each of the three shifts, and perform other incidental maintenance as required. Each man is assigned an area covering one-fifth of the refinery, or approximately 2,200 instruments and control valves.

Instrument Repair

The instrument repair shop is one of the most important divisions in the instrument department. A foreman is assigned to the shop, and his responsibilities include the maintenance of instrument records, instruction manuals, ordering and maintaining adequate supplies of spare parts, and the assignment of shop work. All jobs assigned to the shop are covered by shop orders indicating the date and time the job was received, completed, and returned. There are 14 instrument mechanics and 3 apprentices assigned to shop work.

Because there is such a large variety of instruments throughout the refinery, it is necessary to maintain complete sets of instructions, standards, and specifications. Instruction manuals, standards, and specifications are revised and kept up to date as new and different types of instruments are purchased and installed.

Records of all instruments are kept on cards placed in filing cabinets, and all repairs made to instruments are noted on these cards. Repairs and types of packing and lubricants used are listed on the respective control valve cards.

All instrument parts are stocked by the instrument department. Parts are stored in metal cabinets made up of shelves and drawers which are divided into small compartments. Each section is identified by manufacturer's name, and the parts by name and number.

ALL PRESSURE GAGES are checked and repaired in the instrument shop. Shown here is one of the testing benches. There are two 500-psi., two 4,000-psi., and one 25,000-psi. deadweight gage testers presently in use.

Repair and test equipment . . . Specially designed meter stands are used when cleaning differential-pressure-type meters, to avoid spilling mercury and other materials. The stand consists of a funnellike drain to collect the materials, with a settling tank located below the funnel to catch the mercury. Any other material is drained off above the mercury chamber. This type of meter stand is also located in areas throughout the refinery, and used by repair men in the field.

Positive-displacement meters of all designs are repaired and calibrated in the shop. The meters vary from ½-in. pipe to 6-in. pipe size, and included in that list are dry-gas meters, wet-test meters, and liquid-type meters.

All pressure gages, including all new gages which are stocked in the main storehouse, are checked and repaired in the instrument shop. Cases of new gages are drilled, and 1-in. grommets installed which serve as blowout disks should failure of the Bourdon tubes occur.

There are two 500-psi., two 4,000 psi., and one 25,000-psi., deadweight gage testers, and, in addition, one small vacuum pump, and four manometers varying in range from 10 in. of water to 40 in. of mercury. The manometers are used to test the low-range pressure gages, differential-pressure meters, and vacuum gages. Repair on other instruments is classified into three main groups: potentiometers, analyzers, and other electronic instruments; clocks; and bulb-type thermometers.

It is very important that clean dry air be supplied to all pneumatic devices. To accomplish this, air driers are installed, as well as emergency air compressors to cut in automatically should an air failure occur in the main source of air supply. Emergency electrical generators are also installed to furnish electric current to the instruments should a power failure occur.

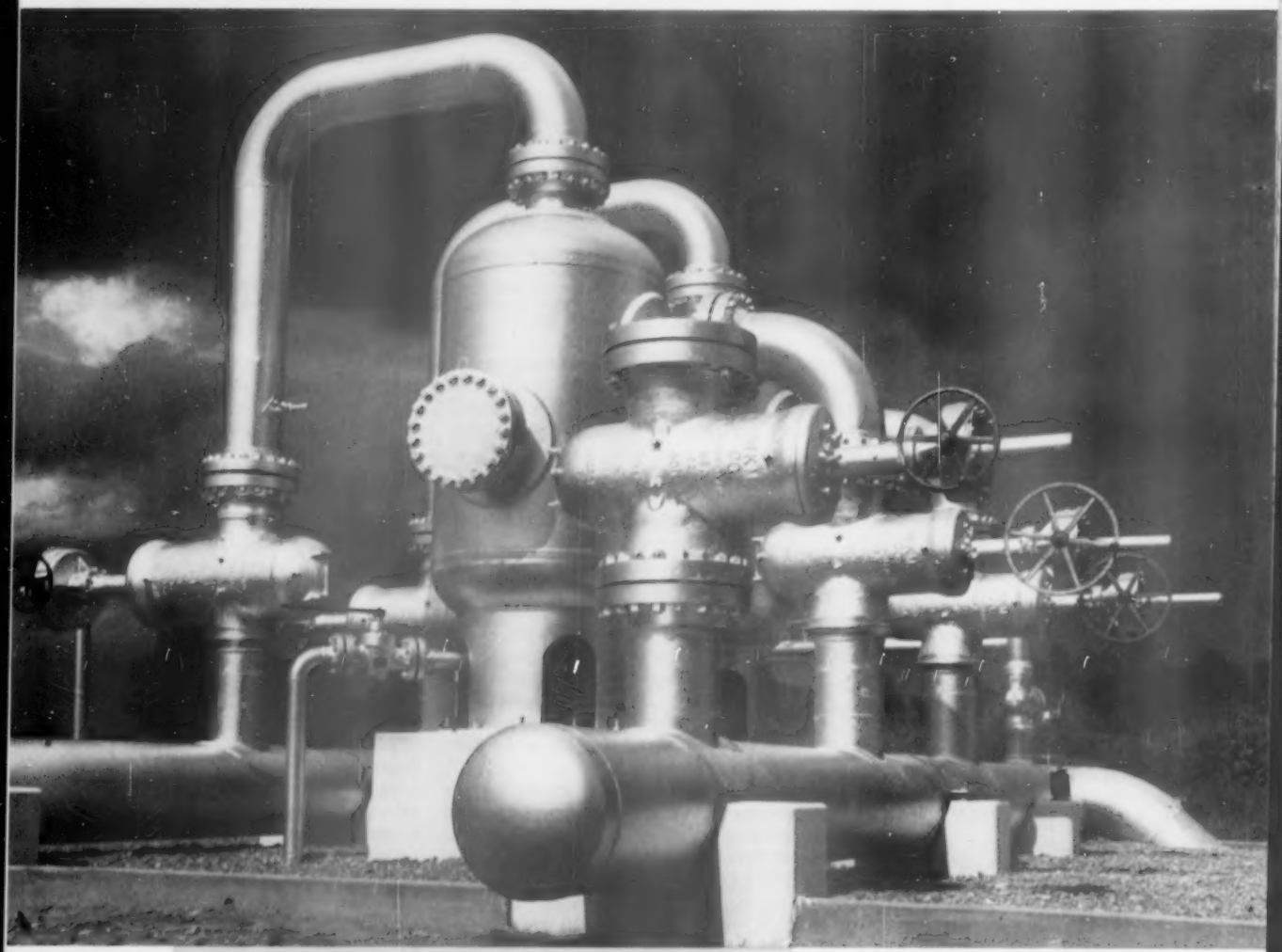
Work Scheduling

A routine work schedule was developed to effect the efficient and coordinated maintenance of equipment in each area. The schedules for the entire refinery are practically the same, with a few exceptions due to unusual differences in some of the areas. Such a uniform program makes it possible for our men to be shifted from one area to another with a minimum of training or familiarization with the equipment. The various items included in the program, and the frequency of periodic maintenance, are based on experience and on recommendations in instrument manufacturers' service manuals.

Work sheets are issued weekly to the men in the field, and are made up for daily, weekly, monthly and quarterly jobs on a 5-day-a-week basis. The work sheets were developed to function on a 4-week-to-the-month basis, with the fifth week included four times each year, wherein all quarterly items are checked. Briefly, the schedule covers the following items:

Typical

. . . of pipeline installations all over the world is this view of W-K-M Through-Conduit Valves at a recently completed Gulf Interstate Gas Company Compressor Station. It is but one of five such stations in which W-K-M Valves are employed, in addition to the many larger W-K-M Valves used in the line itself.



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Daily

Change charts, ink pens, wind clocks.

Date strip charts and set to correct time.

Make out charts for the following day.

Weekly

Check zero and seals on throughput meters.

Check alarms under actual operating conditions.

Inspect emergency instrument air compressor.

Inspect air driers and lubricate air cocks.

Clean slide wires and switches on potentiometers.

Check calibration of analyzers.

Buck-test indicating and recording potentiometers.

Inspect draft gages and check zero.

Inspect all strip chart recorders, ink pads, and refill glass pens.

Monthly

Obtain meter reading on utility meters.

Check pressure recorders with tested comparison gage.

Oil all strip-chart recorders.

Lubricate control valves.

Inspect valve positioners.

Blow down steam and gas orifice-type meter leads.

Differential pressure meters are cleaned and calibrated every 2 years except in specific cases which are determined by general conditions and the service.

Thermocouples measuring transfer line temperatures are replaced each turnaround (shut down for repairs) with tested couples. Turnaround periods vary with particular units, some being on stream a year, some 6 months, others 3 months.

All differential meters using seals are resealed during every turnaround.

Indicating pressure gages are tested every 2 years, except certain gages measuring critical pressures.

Apprentice Training Program

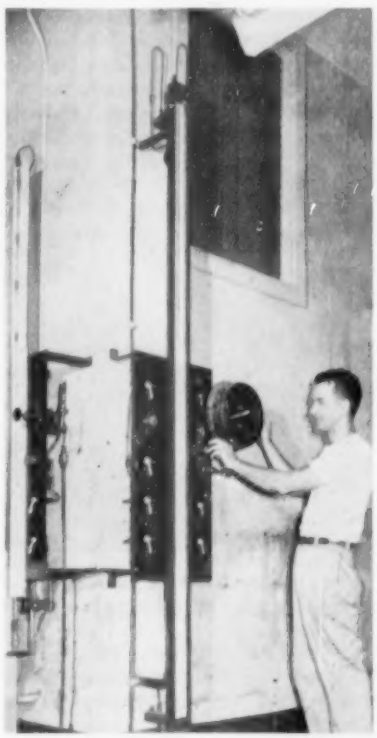
In order that the instrument department may continue to function efficiently, new men are trained continually on an apprenticeship basis. Preventive maintenance work on instruments and control valves is carried out through planned routine assignments for these men during normal operation and turnaround periods.

People selected for the instrument department are required to have a formal high school education or the equivalent. Each applicant is given a written examination to help determine his ability before he is taken into the department. Promotions into the department are always from people who are already employed in the mechanical division.

Until recently, the training of apprentices covered a 2½-year period, during which they worked in the field and in the shop. In 1952, a 4-year apprenticeship program was initiated. This includes on-the-job instruction in the field and in the shop, as well as classroom work.

Formal training classes . . . Under the former apprenticeship plan, there was no formal training course. However, during World War II, and directly thereafter, we found it necessary to include several formal training classes in order to hasten the development of the trainees. These classes were conducted by instructors from the engineering division and from the instrument department. The course comprised certain phases of physics, mathematics, and instrument electrical circuits and theory. Laboratory work in the classroom consisted of dismantling and reassembling instruments, meters, control valves, etc.

The curriculum of the training course included the following subjects: physics, elementary electricity, thermoelectricity; basic electronics, electronic temperature instruments, electronic controls and devices, gas analyzers; pressure, flow, liquid level, thermometry, displacement meters; pneumatic control, control valves, alarm systems, and applications of instruments to processes.



FOUR MANOMETERS are available to test low-range pressure gages, differential-pressure meters, and vacuum gages. Shown here is one of the low-pressure test setups. The manometers vary in range from 10 in. of water to 40 in. of mercury.

Selection of Process Instrumentation

Another important item in good refinery operation is the proper selection of instruments, to assure accurate measurement and control with the minimum of maintenance. To gain this end very close cooperation is maintained between the engineering division, research department, and instrument department. New instruments are purchased and tested in the laboratory for specific applications. The instruments are then installed in the field and a record of their performance is passed on to each group.

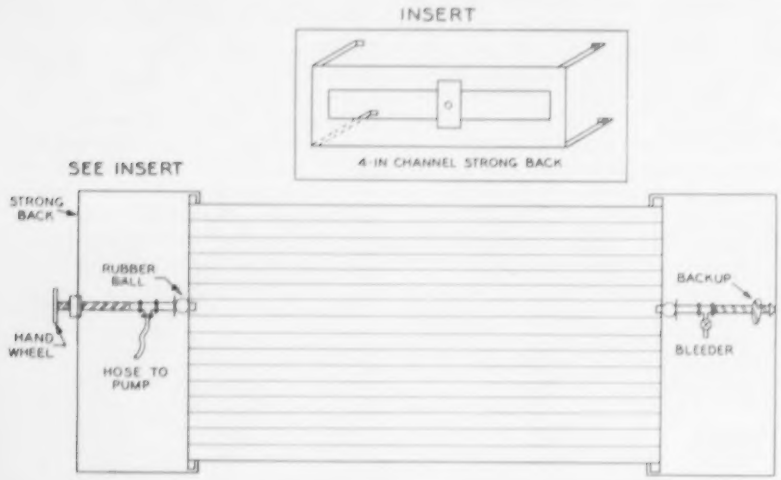
Specifications have been developed for the purchase and installation of all instruments and related equipment. These specifications are used by our organization and are also furnished to contractors. These in turn present to the contractor our general requirements as to types of instruments and our acceptable installation methods. When a new unit is under construction, and has reached the instrument installation stage, a representative from our instrument department is assigned to the unit to observe the general installation. He recommends necessary corrections or changes through the contractor's engineer and our engineering division.

Safety . . . One of the most important items in any organization, and one which cannot be overlooked in an instrument department, is safety. The instrument men are associated with equipment involving nearly every process that is in operation in the refinery. Some of the specific hazards involved are the handling of mercury, sulfuric acid, phenol, benzene, carbon tetrachloride, propane, butane, hydrogen, steam, etc., at high temperatures and pressures.

Supervisors conduct monthly safety meetings with the men in their groups, passing on safety information received while attending supervisors' safety meetings. Each man when assigned to a new area is instructed on certain specific safety regulations concerning that area. Guide books covering all safety regulations are issued to each supervisor, and are used to instruct the men in safe methods and procedure.

Whiting's management is very interested in safety, and a large amount of money is spent annually to purchase safety equipment to protect the workers.

NOTE: This article is adapted from one originally presented at the eighth annual meeting of the National Conference on Industrial Hydraulics in Chicago, and subsequently published in Instrumentation magazine (Minneapolis-Honeywell).



New unit improves tube testing

AN improved method has been developed for individually testing preheat tubes in vacuum domes.

The new development employs a testing unit consisting of two test heads and two portable strongbacks to be bolted to the dome flanges. The strongbacks support the test heads when they seal the tubes under hydrostatic pressure.

The test heads incorporate the standard piping arrangement used when water pressure is used to test tubes individually. However, instead of the ordinary expanding rubber stopper, a hemispherical, cored rubber ball is fitted closely on the ¾-in. test pipe and backed up by a welded boiler-plate washer. The ball seats on the end of the tube under test and is used to seal against leakage.

A threaded stem and handwheel serves to hold the assembly in compression against the end of the tube while 225-psi. hydrostatic test is applied.

A 4-in. channel strongback, designed to hook over the flange of the dome channel head, and capable of lateral movement, furnishes a backup for the end of the compression screw. A similar device equipped with a bleeder valve is used to seal the other end of the 2 by 240-in. tube under test.

The previous method used employed a cored rubber stopper about 1¼ in. long and 2 in. o.d., fitted with a quick-acting expander in each end of the tube to be tested. Hydrostatic pressure was introduced through the axial end of the stopper. Many of the corrosion leaks occur in the tube at a point just inside the ½-in.-thick tubesheet. This point is approximately ⅞ in. from the end of the tube and therefore sealed by the expanding rubber stopper, giving a false tube test.

The current method gives an accurate pressure test, and thereby reduces down time of the unit through this very accuracy.

Method suggested by Arthur M. Edwards, boilermaker, and Marvin D. Edwards, pipe-fitter helper; courtesy Humble Oil & Refining Co., Baytown, Tex.

Oil-leak hunter

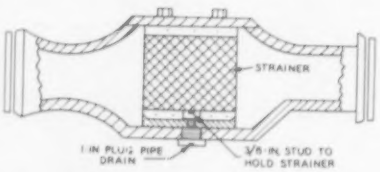
A PORTABLE pump powered by a gasoline engine can be used to test the oil circulatory system on gas engines to locate leaks.

The unit—as developed at La Gloria Corp.'s Falfurrias, Tex., plant—pumps oil through an engine's lube system at a pressure of 35 lb. This will force oil through any leaks so they may be visually observed and corrective steps taken where needed.

The use of the unit merely requires the connecting of a 2-in. hose from the suction of the crankcase to the pump, then connecting the discharge of the pump to the suction of the lubricating system. The gasoline engine is started and the test is run a sufficient length of time to determine if leaking occurs. All of this can be done while the gas engine continues its normal operation.

The equipment involved in the unit includes a spare gasoline engine equipped with a 4-in. pulley which uses a V-belt to drive the 25-in. pulley on the pump. The particular pump—an old one which was already on hand—pumps 300 g.p.m. at a pressure of 35 lb. when driven at 300 r.p.m. The particular ratio between the two pulleys provides for its operating at 280 r.p.m., quite satisfactory for this operation. The pump and engine are mounted on a metal base which can be wheeled about the plant as desired.

The pump can also be used to perform small utility jobs, such as unloading a tank truck. Plant superintendent for La Gloria is H. C. Givens.



Revisions add life

SIMPLE revisions to steam strainers on turbines which drive flue-gas blowers have resulted in longer life for the strainers as well as improving their protective features.

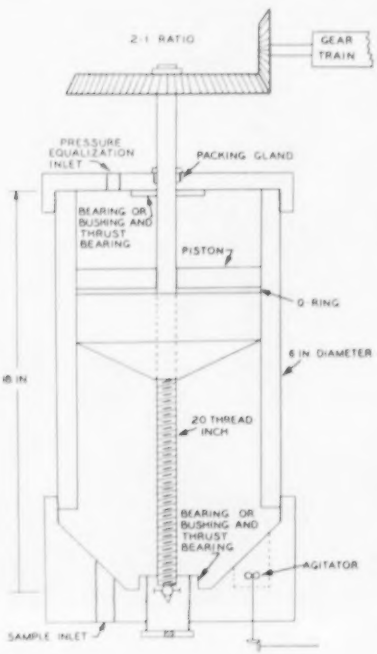
Before the revisions were made, the steam-strainer cartridges consisted of a thin-plate brass cylinder with the bottom end closed and the cylindrical section perforated. The cartridge was supported at the top by a small flange which rested on an annular projection cast in the strainer body. The bottom end of the cartridge was unsupported, there being several inches from the lower extremity of the cartridge to the bottom of the strainer body.

A new-type strainer cartridge was constructed using ½-in. steel plate for the bottom. The length of the unit was extended so the cartridge rests on the bottom surface of the strainer body and is held in place by a ⅜-in. cap screw. The cap screw is threaded into a large

plug in the bottom of the strainer body.

This arrangement provides for rigidity of the strainer cartridge as well as insuring that objects carried in with the incoming steam do not impinge against an unsupported bottom of the cartridge as before, but that the force of the impact is absorbed by the entire strainer body, thus prolonging the life of the strainer.

Method suggested by G. A. Williams. Courtesy Humble Oil & Refining Co., Baytown, Tex.



Varied drives take flow-line samples

VARIOUS drives, depending upon the system desired, can be employed to take a sample from flow lines in accordance with rate of flow or on a continuous basis.

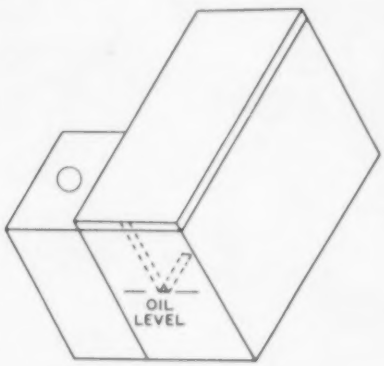
Sampling piping can be connected from the flow line to a sampler which utilizes a mechanically moved piston to allow liquid to enter sampler. Valves are inserted in the piping to permit liquid to be removed from the sampler, and necessary line included for equalizing pressure in the sample cylinder.

Piston travel is accomplished through gear drive to the piston being powered by either an electric or liquid motor. In proportional sampling, the electric motor may be actuated through a mercoid switch arrangement with a flow meter which determines rate of flow across the orifice in the flow line and causes the electric motor to operate according to this rate.

A liquid motor or turbine can also be employed with the proportional sampler which is driven by the flow differential across the orifice in the flow line. This also operates to drive the piston in relation to the rate of flow.

The continuous sampler merely uses an electric motor to drive the piston at a predetermined rate to obtain a sample of the flow on a continual basis.

Method suggested by Donald Y. Baldwin, mechanical superintendent, Humble Pipe Line Co., Tomball, Tex.



Oil gage stops waste

FOR a horizontal engine on which the oil-reservoir box is not provided with a level, B. L. Hunter, of Phillips Petroleum Co.'s natural-gasoline department, suggests that a simple oil gage be installed.

Without a gage, care must be taken in adding oil. The oil level drops when the engine is running, hence if too much oil is added the reservoir will overflow when the engine is stopped. This means waste of oil and a messy engine and floor. The level marker is installed to indicate proper level when the engine is running as indicated in the illustration.

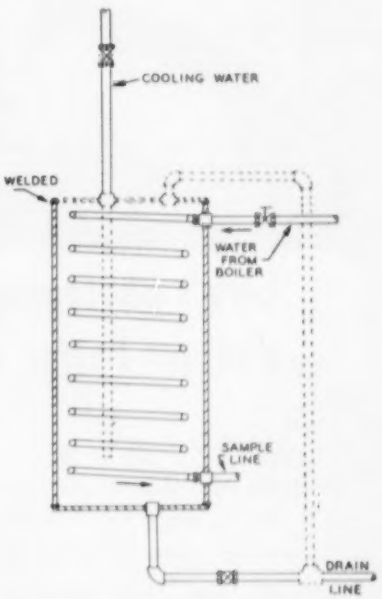
Wing-plate holes reduce down time

THE scavenger cylinders and parts on certain models of compressor engines at Phillips Petroleum Co.'s Fullerton gasoline plant are cleaned several times per year. It is necessary to remove the scavenger air elbows for thorough cleaning. The scavenger air elbow on the No. 1 cylinder, however, is made with a wing plate extending to the instrument case. This wing plate is located 2 in. in front of the capbolts fastening the scavenger air elbow to the cylinder. Furthermore, this wing plate has a welded reinforcement attached to the scavenger air elbow flange. The wing plate serves no purpose other than improving the appearance of the engine.

The space available to remove the two capbolts below the reinforcement and behind the wing plate is too small for all but the smallest wrenches. To remove these capbolts, it is necessary for the repairman to stand on one foot on the corner edge of the engine main frame. The repairman must then reach through an 8-in. opening between the wing plate and the instrument case to work on the capbolts underneath the welded reinforcement.

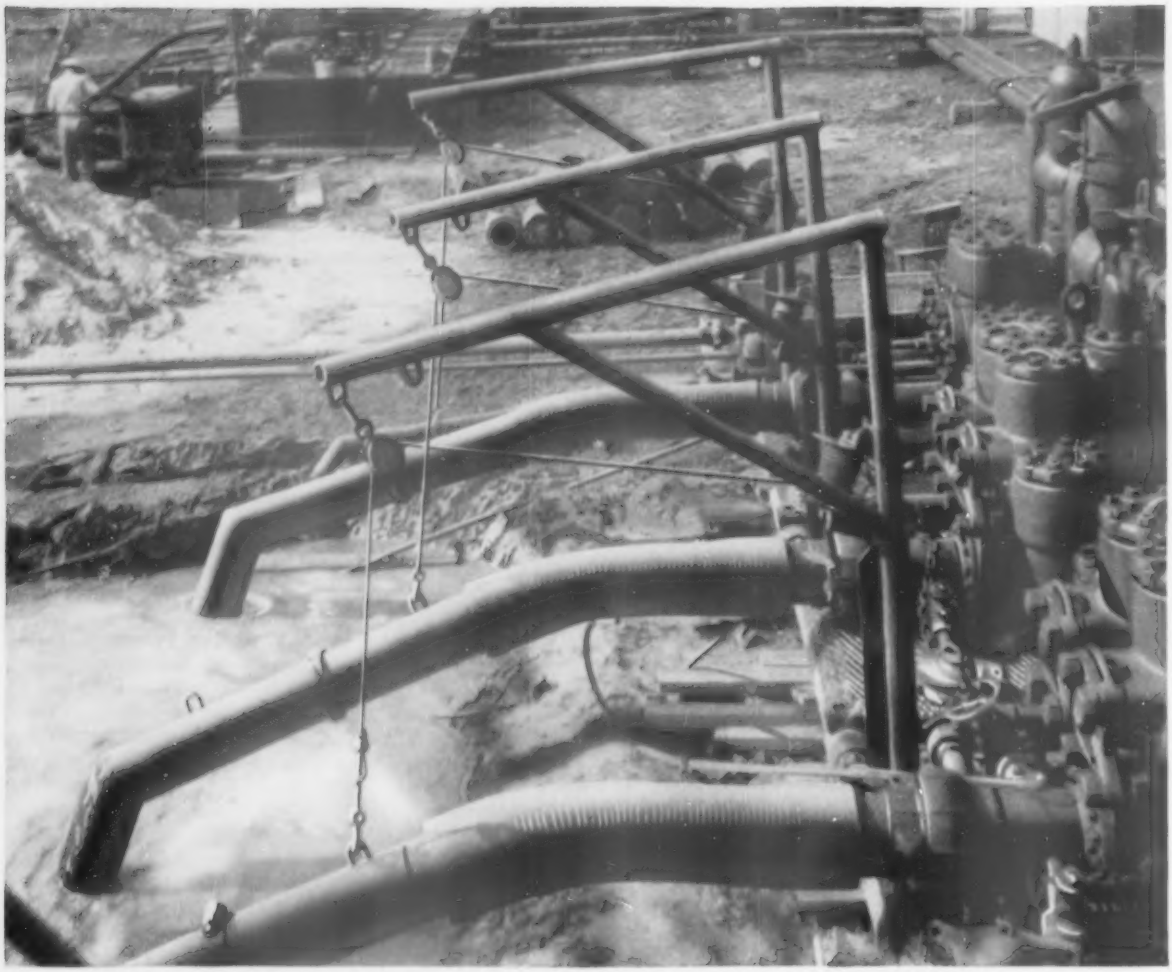
Under these conditions, work is slow and somewhat hazardous.

It was suggested that a hole 1½ in. in diameter be drilled through the wing plate directly in front of the capbolts. These holes allow the repairman to remove the capbolts from a standing position on the engine catwalk. In this manner, removal of the scavenger air elbow is made easier, the time saved per engine amounting to between 20 and 30 minutes. Suggested by J. F. Graham, Phillips Petroleum Co., natural gasoline department.



Better sample cooler

THE original installation (solid lines in the sketch) was unsatisfactory due to overflowing and restricted cooling facilities. Revision was made as shown by the dotted lines. These revisions permit increased flow under plant pressure of cooling water leading to adequate cooling of the boiler-water samples and greater sampling accuracy. Suggestion for revisions was made by H. A. Watkins, Phillips Petroleum Co., natural gasoline department.



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● A close look at this photograph reveals these facts:

(1) All equipment is *dry*, although no cumbersome clamps hold the hose in position. There are no leaks; no lost pumping pressure.

(2) Hose covers are not puckered at the bottom nor stretched at the top of the hose bends. The hose curves smoothly without stress or strain.

(3) No cuts or worn spots are evident, yet this Republic Hose has seen long service on this and other jobs.

Other features, not visible here, include special smooth bore, abrasion-resisting tubes and strong, flexible round-wire helix reinforcements that prevent collapse from suction.

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Sampling for Continuous Analysis—5

by C. G. Fellows

IN the preceding installment a mix weir was described. This is part of a sampling system for a chemical-process tails liquid containing lime. Measurement is made of the charge in CO_2 content of the liquid sample after the lime is reacted with CO_2. This series on continuous-analysis sampling is concluded with description of the complete sampling system for the tails liquid.

In the mix weir, the lime and CO_2 react and a sample of the liquid, after the reaction has occurred, is taken off through D which is simply a ⅛-in. o.d. stainless-steel tube with a fine mesh screen surrounding it to keep the remaining gummy substance from plugging it up. All of the remaining mix-weir liquid passes to a drain via an orifice through which cleanout plunger B is seen to extend. The overflow slot J is provided in case the drain orifice plugs up. The actual liquid level in the mix weir is about 3 in. below the orifice E. The temperature of the liquid in this weir is held to 50° ± 1° C. by immersing the bulb of a self-actuated steam regulator in the mix-weir liquid which controls the steam flow into the heating coil of the water weir. Thus, the water temperature is varied to hold the mix-weir-liquid temperature as required.

Author is with Carbide & Carbon Chemicals Co., South Charleston, W. Va., in special instrumentation department. Paper presented at 1954 Texas A. & M. instrumentation symposium.

Cleanout-plunger system . . . This operates as follows:

Plungers A and B—about 24 in. long—are suspended from a crossbar so that they are free to pass through their respective orifices without binding. The crossbar is actuated by a double-acting pneumatic cylinder which moves it up and down. A second double-acting pneumatic cylinder is mounted horizontally and moves cleanout plunger C horizontally. Two parallel circular rods act as guides for aligning C with its orifice in the horizontal plane. All of this cleanout-plunger system is mounted on a removable partition K which slides in a pair of slotted guides which have gaskets at the back of their vertical slots for liquid-seal purposes.

The two double-acting pneumatic cylinders have a 2-in. stroke, a 1¼-in. diameter bore, and are actuated by air supplied from an air-operated four-way valve and according to a time cycle set by a converted valve positioner used as a pneumatic oscillator. The time for the cleanout was set at 3 seconds, and 27 seconds was the set time between successive cleanout times.

The orifices through which A and B pass are computed for specific flow rates and are sized to include the ¼-in.-diameter plunger rods which always extend through them. On each of these shafts is a cylindrical section held in position by two cones pinned to the rod. The total length of the cylinder and cones is ⅝-in. and due to the 2-in. rod stroke pass completely through the orifices,

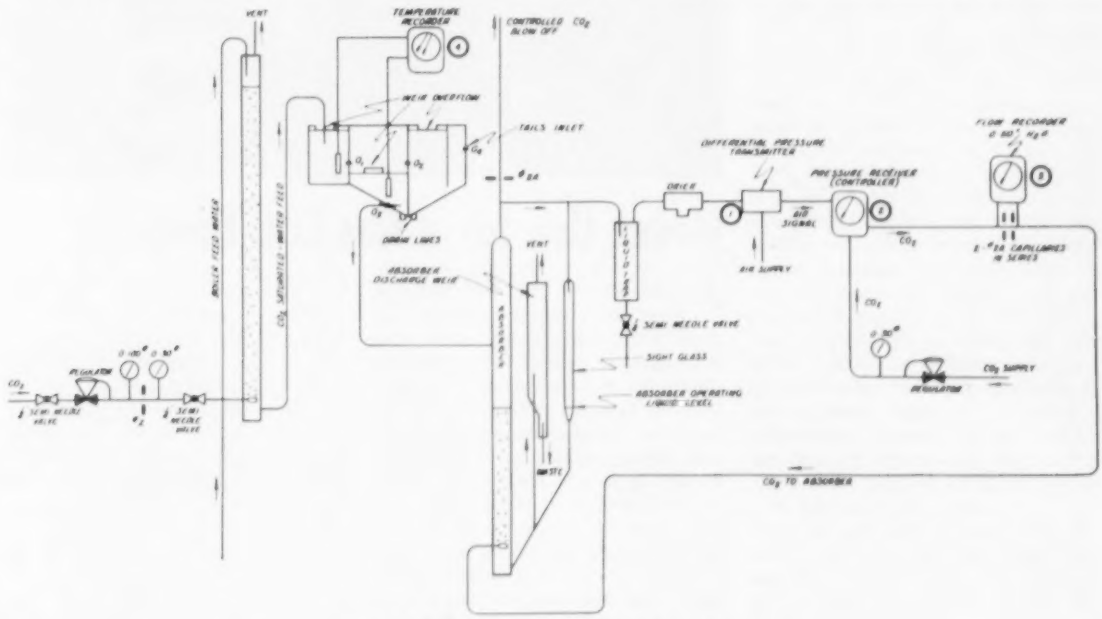


Fig. 4—Flow diagram for lime in tails analyzer.

cleaning them out and obstructing flow for only a fraction of a second of the 3-second cleanout time.

From the mix weir a liquid sample is continuously withdrawn through D—shown as Orifice 3 of Fig. 4—to be analyzed for the variability of its CO_2 content which is proportional to the lime content reacted out of the sample liquid.

The means by which the measurement of this CO_2 content is effected are shown schematically in Fig. 4 and described as follows:

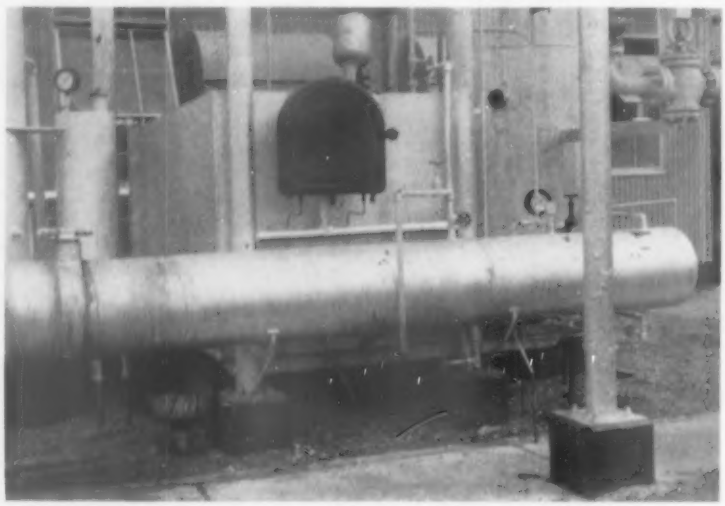
At the left of this drawing is shown the manner in which CO_2 is added to the water for reaction in the mix weir. The water pours into an open-ended piece of 2-in. pipe and the CO_2 is admitted at the bottom of this water column through a sparger. This sparger consists of a piece of ¼-in. o.d. rubber tubing fastened to one end of a section of ¼-in. o.d. stainless-steel tubing. A piece of ⅛-in.-diameter wire is welded to the stainless-steel tubing and extends into the rubber tube which is tied off at its lower end. The wire is then bent in a circle so that the rubber tube assumes a circular shape at right angles to the vertical axis of the pipe. The upper surface of the rubber tube is pierced with a series of small holes which close after the small drill used to make them is removed. Under sufficient gas pressure these holes open and admit the CO_2 into the water. When the gas pressure is less than the water head, the holes close up, thereby preventing liquid back flow into the gas system.

The final liquid sample from O_3 enters a CO_2 absorber column at a rate of approximately 10 cc. per second, passes down through it, then up through a drain line to a weir which holds a constant liquid level in the absorber and finally from it the flow is to a sewer. The top of this weir is vented to the atmosphere. A sight glass is connected between the liquid drain line from the absorber and the gas phase at its top. The gas phase is vented to the atmosphere through an orifice. CO_2 is admitted into the liquid through a rubber tube sparger—same as described for the water column—located near the bottom of the absorber. With the tails liquid shut off, the liquid sample is simply the CO_2 charged water entering the mix weir. This represents the "zero" lime concentration condition and for this the rate of CO_2 admitted into the column is adjusted so that it will build up 6 in. of water pressure in the gas phase of the absorber between the liquid surface and the vent orifice. The sight glass is a convenience for observing this gas pressure.

Transmitter . . . A pressure connection is made between the gas phase of the absorber and a pressure transmitter (1) of Fig. 4. This air-operated transmitter commands a controlling pressure receiver (2). The pneumatic system of this controller is operated by the CO_2 supply used for the absorber. The CO_2 leaving the pilot valve passes through an orifice or orifices and the flow through them is recorded by a 20-in. differential-pressure flow recorder (3). From these orifices, the CO_2 flows into the sparger tube of the absorber. When the zero lime-content point is set, the CO_2 rate adjustment to establish the 6-in. H_2O gas pressure results in a flow rate of about 1 in. of H_2O on the 20-in. recorder (3). If now lime via tails liquid is admitted to the mix weir, CO_2 is reacted from the liquid therein and the liquid in the absorber becomes deficient in CO_2 and robs the gas phase above it. This causes the controlled pressure point of 6 in. of water to drop and, therefore, the pressure transmitter commands the controlling receiver to increase the rate of flow of CO_2 into the absorber column to compensate for this loss. The flow of CO_2 as recorded by the flow meter (3) is calibrated in terms of the per cent by weight of lime in the tails liquid.

The completeness of the reaction and the calibration were established by titrating the tails liquid using phenolphthalein.

The two-pen temperature recorder was used to check for the widest temperature-control tolerance compatible with the acceptable tolerance for the lime measurement.



Novel Use for a Gas-Lift Timer . . .

AT the Stratton gasoline plant of Southern Minerals Corp., on the Texas Gulf Coast, it was found that the corrosion inhibitor added to plant water was most effective if slugged in using a certain amount at periodic intervals. Having some spare gas-lift equipment available, it was a simple matter to install the gas-lift time-cycle controller to do the job.

A choke was installed in the line which allowed the proper amount of solution to enter the water system under the constant pressure which was kept on the tank for a period of approximately 15 minutes every 2 hours. The controller was then installed to operate a diaphragm valve on the discharge line of the tank for the proper period of time. Then it was simply a job of keeping the clock wound and letting the controller do the job. Measured amounts of chemical were put into the large vessel and a check kept to see that the tank was emptied in the proper length of time.

Now when the plant water is checked for hardness, it is a simple matter to adjust the time-cycle controller to stay on the job and inject the proper amount of chemical.

Hints for Drillers Who Want to Stay Healthy

by J. R. Yost

THE most important step in eliminating accidents in handling drill pipe, working around the rotary, and handling the spin chain is careful training of the driller. He must be trained to observe such rules as these published by the State of California as "General Petroleum Industry Safety Orders for Drilling and Production," Section 6645, which pertains to handling of spin chain:

1. Chain shall not be used wholly or in part with any cathead except as a spinning line.

2. Chain shall not be used in any spinning line with an automatic cathead unless such cathead is equipped with a manually operable cathead clutch or other device adequate to keep the rotation of the cathead under control at all times it is in use. Such clutch or device shall be of a type that will automatically release when not manually held in the engaged position.

3. Chain used in a spinning line shall be of an approved type.

4. Every chain used in a spinning line shall have a fiber tail rope, 12 to 24 in. in length, securely fastened to the end of the chain at the pipe. When such spinning line is being used to rotate a pipe, the employe handling the pipe end of the line shall hold to the tail rope and not to the chain. (Many, however, believe that the tail should never be over 8 in. in length, because a long tail rope has caused many broken, mashed, and bruised arms, fingers, etc. This is caused by the tail rope getting a hitch or wrap on a man's hand.)

5. Every spinning line that contains chain and is manually operated on a cathead shall have a fiber rope securely fastened to the cathead end of the chain. Strength of such rope shall not exceed that of the chain. Only the fiber-rope part of the line shall be permitted to come in contact with the cathead.

6. A chain having a broken or distorted link or a link with the metal reduced by wear at any point to less than 90 per cent of its original cross-section area shall be discarded at once from further use as a spinning line.

7. The use of spliced chain, either new or old, in a spinning line is prohibited.

8. Before an employe is required or permitted to use a spinning line that contains chain, he shall be given adequate instructions in its safe use.

Many accidents to hands, legs, and feet could be eliminated, especially on standard derricks, if a drillpipe racking hook were used while making trips. It is strongly recommended that contractors equip each rig with a suitable hook for this purpose.

Author is with the Zephyr Drilling Corp., Tulsa. Paper presented at the 1954 A.A.O.D.C. Safety Clinic, Dallas.

Around Rotary Tables

There are many more items that could be added, but if these are followed by the crew and enforced by the driller, many accidents can be eliminated around the rotary table.

Slippery floors are the cause of a large percentage of accidental slipping and falling. It is recommended:

1. Flooring be built of good heavy material, as near flat and level as possible.

2. New roofing paper, or suitable nonskid material, should be used on all working areas wherever possible.

3. Toe holds or cleats should be used only when necessary.

4. Drain holes should be in low places to drain drilling mud from the floor.

5. Pipe racks should be constructed of material that allows stands to drain while racked in the derrick.

6. Flat, level covers for all openings in the floor (mouse hole, rotary lock, etc.), should be available and used.

7. All guards and rails should be in place at all times.

Handling drill-pipe tongs, slips, and spin chain.

1. A position on the inside or throat of the tongs and close to the drill pipe should be kept by the men at all times, both going in and coming out of the hole. This position will keep men away from whipping chain and tong lines.

2. Hands should never be close to a joint in the jaws of the tongs. One hand should be on handle of lead jaw and one hand on handle of tongs while coming out of the hole. While going in the hole, hands should be on the jaw handles.

3. Crew members should examine tong lines for proper clamps and frayed ends of cables each tour. Lines should be straight clamped with no hitches or knots.

4. Derrickmen should examine tong derrick lines and sheave at least weekly.

5. Use long spinning chains. Take enough wraps around the pipe to make certain that the chain will not slip before the joint is jammed.

6. It is most strongly recommended that a soft-rope tail be used on the spinning line and that this tail never be over 8 in. in length.

7. Drillers should always have all the slack out of the cathead line before they throw all the power into spinning up the joint.

8. Floormen should handle slips with palms of hands up.

9. When pulling the slips, lower the body by bending the knees and not the back. Let the legs do the lifting, avoid using the back for heavy or awkward load lifting.

IN SPITE OF HIGH WATER

A CAT* SPREAD KEEPS ROLLING

HIGH WATER on the right-of-way has not bogged down this Bucyrus-Erie dragline powered by a rugged Cat D318 Diesel. Operating from wooden mats, the dragline continues to backfill the trench between Hawkins and Longview, Texas. Work is being done by O. R. Burden Construction Co., Tulsa, Oklahoma.

"Caterpillar equipment," reports R. M. Jones, superintendent on the job, "will last longer with less maintenance than any other equipment I've ever used."

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A WORD TO THE WISE— STANDARDIZE!

by W. L. Nelson
Technical Editor

Maximum Variations in Heating Value of Residual Fuel Oil

"Does the heating value of Bunker C fuel oil vary widely? What is the maximum variation?" S. M. T.

On a volume (per barrel or per gallon) basis the heating value of commercial residual fuel oils does not vary much, being generally in the range of 6,100,000 to 6,600,000 B.t.u. per bbl. On a pound basis, the variation is greater because the heavy carbon-rich oils have relatively low heating values.

The main variables are:

1. A.P.I. gravity. Low - A.P.I.-gravity oils have lower heating values on a pound basis, but, of course, their weight in pounds per gallon or per barrel is larger.

2. Kind of oil. The asphaltic or highly cracked oils of low characterization factor have lower heating values.

3. Sulfur. Sulfur has a lower heating value than the hydrocarbons of fuel oils. Thus, the approximate lowering in heating value for each 1 per cent of sulfur is:

$$\frac{0.01\,(18{,}250 - 4{,}050)}{18{,}250} = 0.0078 \text{ (or 0.78 per cent)}$$

4. Inerts. Water, sediment, pipe scale, ash, and probably nitrogen and oxygen do not contribute to the heating value. The total percentage of these seldom exceeds 2.5 per cent and may be well under 0.5 per cent. A correction for 1.5 per cent of inerts was made in any computed heating values shown herein.

Table 1 shows typical fuel oils. At one extreme are highly cracked oils that derive from naphthenic crude oils such as those of California or Venezuela. These are illustrated by oil A. At the other extreme are substantially straightrun residues of high A.P.I. gravity (oil E) such as some of the fuel oil sold in the Caribbean Sea or in Europe. Among these typical oils, maximum variations amount to only about plus or minus 2 per cent.

The effect of sulfur on cracked fuel oils of different gravities is indicated in Table 2. In the extreme, heating values may range from about 6,100,000 B.t.u. per barrel for high-sulfur, high-b.s. and w. oils to nearly 6,600,000 B.t.u. for low-sulfur, straightrun products of intermediate-base origin.

Lower values sometimes found in the literature are usually due to the inclusion of distillate fuel oils (of lower heating value) in residual fuel oils. This is sometimes necessary in preparing statistics. Value shown in the literature are:

Bituminous Coal Institute	6,287,000
Petroleum Data Book (13 A.P.I.)	6,380,000
West Virginia University (Bureau of Business Research)	6,200,000

TABLE 2—HEATING VALUES OF AVERAGE RESIDUAL FUELS—MILLION B.T.U. PER BARREL

A.P.I.	No sulfur	Cracked 1% S	2% S	3% S	4% S	5% S	6% S	Avg.
5	6.58	6.52	6.47	6.42	6.36	6.31	6.26	6.42
6	6.52	6.47	6.42	6.36	6.30	6.25	6.20	6.36
7	6.45	6.41	6.36	6.30	6.25	6.21	6.13	6.30
8	6.48	6.43	6.38	6.32	6.27	6.22	6.16	6.32
9	6.51	6.45	6.40	6.35	6.29	6.24	6.19	6.35
10	6.47	6.42	6.37	6.32	6.26	6.21	6.16	6.32
11	6.43	6.39	6.34	6.28	6.23	6.18	6.13	6.28
12	6.43	6.39	6.34	6.29	6.24	6.20	6.14	6.29
13	6.49	6.44	6.38	6.33	6.28	6.23		6.36
14	6.54	6.49	6.43	6.38	6.33	6.27		6.41
Average	6.49	6.43	6.39	6.34	6.28	6.23	6.17	6.34

Weight of a U. S. Gallon

"Is not the figure of 7.5 lb. per U. S. gallon an arbitrary one with the weight of the contents of a barrel or drum being determined by the specific gravity of the material in the barrel?" H. G. B. P.

The weight of a U. S. gallon of water is 8.328 lb., and the weight of other liquids that have different specific gravities is obtained by multiplying 8.328 by the specific gravity. Thus, a gallon weight of 7.5 lb. corresponds to a specific gravity of 0.9007 (or an A.P.I. gravity of 25.6).

There may be an arbitrary use of 7.5 lb. as the weight of a gallon because very many such arbitrary uses have arisen. As an example, some of the conversion factors used by governments to convert metric tons (2,204.6 lb.) of crude oil into U. S. 42-gal. barrels, are:

Argentina	7.177	Iran	7.566
Bahrain Is.	7.328	Iraq	7.481
Canada	7.858	Kuwait	7.550
France	7.129	U.S.A.	7.401
Germany	6.993	Venezuela	6.703

These great variations indicate that values are selected in each instance that represent the specific gravity of the crude oil being currently handled.

TABLE 1—TYPICAL FUEL OILS FROM VARIOUS SOURCES

No.	A.P.I.	Kind of fuel—	Characterization factor	Per cent sulfur	B.t.u. per lb.	B.t.u. per gal.	Lb. per bbl.	B.t.u. per bbl.*	Main use
A	5	Highly cracked naphthene base (as Calif.)	10.2	4.8	17,500	151,000	362	6,330,000	Industrial
B	7	Cracked mixed base (as medium Venezuelan)	10.4	2.7	17,950	152,300	357	6,400,000	Industrial
C	9	Cracked mixed base (as Ill., Mid-Cont., etc.)	10.6	0.85	18,350	153,500	352	6,450,000	Industrial
D	12	Mildly viscosity broken (as Caribbean)	10.8	2.95	18,200	149,000	345	6,260,000	Bunkering
E	14	Straightrun products (as Caribbean)	11.45	2.2	18,900	153,000	340	6,430,000	Bunkering

*Corrected for characterization factor (percentage of carbon and hydrogen) and for percentage of sulfur, as well as minor amounts of nitrogen, oxygen, and 1.5 per cent b.s. and w.

Reflex type, internal tube model

get accurate level reading of hot or cold liquids

with Jerguson Heated and Cooled Gages

Here's your answer if you have the problem of getting accurate level readings of liquids that boil or surge or liquids that are heavy and don't flow at normal temperature. Jerguson Heated and Cooled Gages are specially designed and built to carry a cooling circulating medium to control boiling tendencies . . . or a heating circulating medium to speed the flow . . . so you get *accurate* readings. These gages are also ideal in cold weather applications for they can be heated to prevent gage freezing and breakage.

Jerguson's high standards of design are followed throughout; and materials are selected to exceed or conform to A.I.S.I., A.S.T.M. and/or A.P.I.-A.S.M.E. requirements. Available in external or internal tube models, reflex or transparent types, in a large number of sizes and pressure groups.

You'll get rid of the troublesome problems involved in steam tracing and won't have to insulate gages or valves, you'll eliminate the problem of getting accurate level readings of hot or cold liquids, and you'll cut maintenance hours and costs with Jerguson Heated and Cooled Gages. Send for detailed Data Unit and full information.

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Expansion Started

Aurora will boost octane with new processing units

DETROIT.—Aurora Gasoline Co. has announced a $4,500,000 program to boost distillate yield and quality at its 35,000-bbl. per day refinery here. Included are four new processing units, none of which will add a barrel to crude capacity.

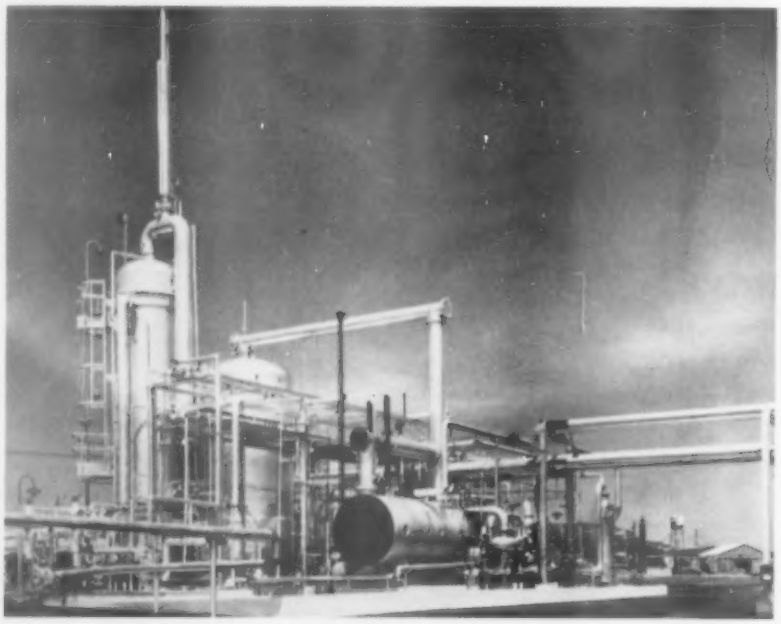
In going in for fluid coking, Unifining, sulfur recovery and fluid catalytic cracking expansion, the company will move into the front rank in ability to convert crude to tailor-made products.

The new fluid coker will be the first one outside the Standard Oil Co. (N. J.) family where it was developed. This first licensed unit will convert 4,000 bbl. per day of heavy vacuum bottoms to distillate products and fluid coke. The coke and other distillates will further be improved in a 7,500-bbl. per day Unifining unit. Utilizing the hydrogen produced in the plant's 6,000-bbl. per day Platforming unit, the Unifiner will be the first of its type to produce high quality furnace oils. The unit is also designed to process heavy vacuum gas oil, according to Aurora.

Another first . . . The company will chalk up another first in installing initial sulfur recovery unit in the Detroit area. This plant will convert hydrogen sulfide separated from Unifiner, Platformer, and other gas streams to 30 tons of high purity elemental sulfur per day. This project resulted from the cooperative effort of the company and B. J. Linsky, head of the Detroit Smoke Abatement Bureau.

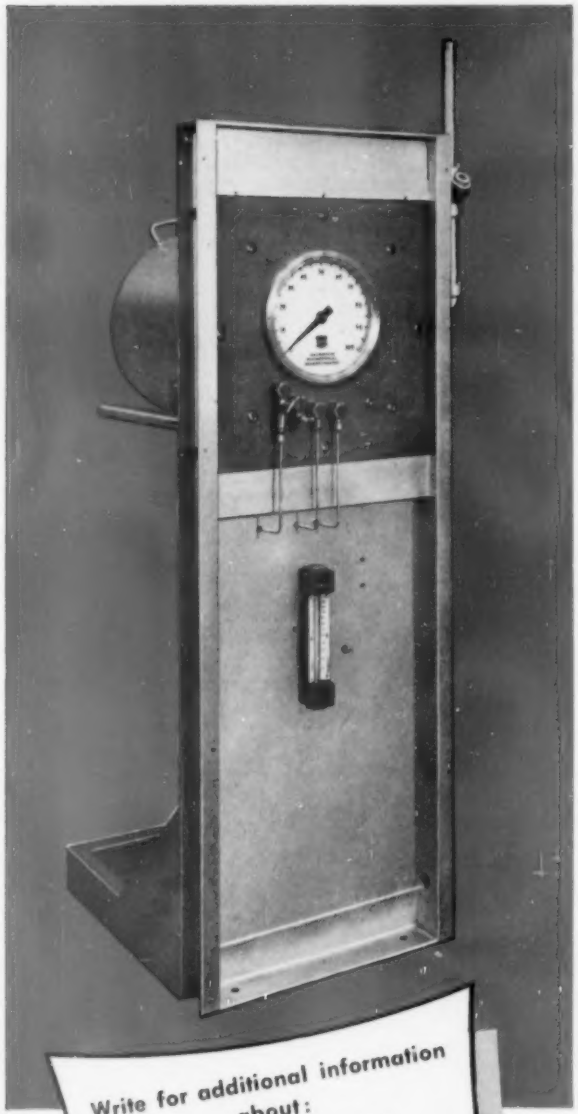
Ralph M. Parsons Co. of Los Angeles has the construction contract for the coker, Unifiner, and sulfur unit. A second construction contract has been signed with Procon, Inc., of Des Plaines, Ill., for the immediate installation of a fluid catalytic cracking unit to be designed by Universal Oil Products Co. of Des Plaines. Addition of this new unit will more than double Aurora's cat cracking capacity, now carried out in a 12,000-bbl. per day plant completed in 1947.

Modern unit . . . Embodying the latest improvements in catalyst stripping,



Sulfur Recovery Unit Removes 40 Tons Daily

Lago Oil & Transport Co., Ltd., a subsidiary of Standard Oil Co. (N. J.), has put this sulfur recovery unit on stream at its Aruba, Netherlands West Indies, refinery. The gas purification unit is a Girbotol unit which employes a diethanolamine solution in removing hydrogen sulfide from a sour gas fuel stream. The hydrogen sulfide is then pumped to a second section of the installation where the sulfur recovery unit converts it to elementary sulfur. Because of the short supply of fresh water on the island, the facilities are designed to use sea water for cooling.



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the new fluid unit will have a capacity for charging 14,000 bbl. per day. It will raise the Detroit refinery to top position in catalytic cracking capacity based on crude charging capacity. Including a smaller refinery at Elsie, and a 10,000-bbl. per day refinery at Muskegon, Mich., acquired last year on a long term lease from Old Dutch Refining Co., Aurora controls a total of 52,500 bbl. per stream day in crude capacity. When the new Detroit facilities are placed on stream next fall, the company will maintain catalytic cracking capacity amounting to 53 per cent of crude capacity. It now has three Platforming units which constitute nearly 21 per cent of crude capacity. New facilities coupled with the company's present high conversion operation will boost the octane potential to a new high.

First U. S. Airline Jets To Use Kerosine-Range Fuel

WASHINGTON. — Capital Airlines has decided to purchase a conventional jet fuel boiling in the kerosine range, for its new British jet planes which will be delivered next spring. Forty Vickers-Armstrong Viscounts, which the airline has purchased, will begin to appear next April.

Capital was undecided whether to use a conventional JP-4 fuel, a similar blend in the kerosine range, or low octane gasoline. They felt the latter might be more available, but are understood to have been assured that the higher-boiling kerosine blend will be available at a suitable price. Commercial jet fuel consumption is estimated to rise from 10,000,000 gal. next year to many times that by 1960. Capital is the only domestic airline to order jets to date.

Refining Briefs

NEW YORK.—"Esso Multi-Purpose Grease H" has been announced by Standard Oil Development Co., Jersey Standard affiliate. Fibrous in structure, the grease has water and high heat resistant qualities. It can be used for auto chassis, water pump, and wheel bearing lubrication, and for tractors, farm equipment and household appliances.

LINDEN, N. J.—Esso Standard Oil Co. plans to add a Hydroforming unit at the Bayway Refinery, Linden, N. J. Work has commenced on the dismantling of a battery of pressure thermal cracking units built 25 years ago, to make room for the new catalytic reforming unit.

Introducing THE NEW OILCO CUSTOM-BUILT LONG-RANGE LOADING ASSEMBLY

To meet the advancing needs of the industry

No. 462
Sizes: 3" x 4"

This newly designed and successfully-field-tested assembly of extreme long range, without re-spotting, loads transports and tank cars with unsurpassed speed, greater flexibility and trouble-free handling. It includes two of the new Oilco (No. 887) swing joints, equipped with *TIMKEN tapered roller bearings* which insure greater friction-free load capacities.

These new swing joints are packed with "O" ring seals operating against heavy chrome surfaces to guard against leakage and wear. Repacking time less than 15 minutes for complete assembly, without dismantling any connections.

The assembly and alignments are perfectly engineered in keeping with Oilco's high standards with precision hardened ground bearings and races on all swing joints, except No. 827. Soft or flame-hardened materials have no part in the construction.

No. 827 swing joint provides 360-degree rotation of the drop tube and is provided with handle to facilitate operation.
Compression springs which never fatigue, operate in conjunction with perforated lever arms to accomplish desired torque and angles of vertical movement. Thereby, the vertical movement is spring-balanced and the loading arm remains in loading position without locking devices or manual effort. The assembly will rise 60 degrees above and descend 45 degrees below horizontal.
The assembly includes No. 150 self-closing shock-proof loading line valve; and a Timken bearing pillow block at the top of the riser which dispenses with the need for an additional swing joint. All joints are grounded with static connections.
Completely assembled at the factory. Bolt up the flanges and you are ready to proceed with speedy, care-free volume loading.

Write for descriptive folder, A-2, for added details.

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Among the

Drilling Contractors

Anschutz Rigs Busy In Rocky Mountain Region

Anschutz Drilling Co., Inc.'s Rocky Mountain division, with headquarters in the Johnson Building, Denver, reports four active contract operations, one a well drilled for Magnolia Petroleum Co. in Banner County, Nebraska, and now being completed.

Drilling are a Lakota test for Natural Gas & Oil Co. on Hat Six Ranch, in Converse County, Wyoming; a Tensleep test for Cyprus Mines Corp. in the Buffalo Springs area, Hot Springs County, Wyoming; and an 8,200-ft. Morrison test for J. Ray McDermott at Clarks Fork, Carbon County, Montana.

H. W. Addington, Denver, is in charge of the division's drilling operations. E. W. Unruh, located at Casper, Wyo., is field drilling superintendent. Tool pushers are: Red Lovell, Nebraska; Fred Schwettman, Hat Six Ranch; Bob Mangan, Buffalo Springs; and Don Haney, Clarks Fork.

Otis W. Dyer, Jr., Houston, will do the drilling on a 14,000-ft. test Atlantic Refining Co. is undertaking in the Grassey Lake area, in St. Martin Parish, coastal Louisiana. The test, a wildcat, will be on State Lease 2379, which is northwest of the new East Lake Palourde field, in Assumption Parish.

Glenn Peel, Hoisington, Kans., has a rig on a rank wildcat, 20 miles from nearest production, in Osborne County, northern Kansas. The test, 1 Enochs, being drilled for White River Oil Co., is 1 mile south of Osborne, east of development on the Central Kansas Uplift. Location is in 25-7s-13w.

Arnold Oil Well Service Co. has a rig working for South Texas Oil & Gas Co. at 1 Tolson, a wildcat test located 12 miles northeast of Victoria, in Victoria County, South Texas.

H. L. Rowley, Inc., Shreveport, is under contract to Placid Oil Co. for a Lower Cretaceous test 7 miles southwest of South Carlton field, in northern Baldwin County, near the Mobile County line, in southern Alabama. The test 1 Bacon-McMillan, northeast of Mount Vernon, is scheduled to go to 8,300 ft.

Crow Drilling Co., Shreveport, is scheduled for an 8,500-ft. test to be drilled in eastern George County, in southeastern Mississippi, near the Alabama line. The test, 1 Boss, in C NE SE 11-2s-5w, is a joint venture of I. P. LaRue, G. G. Stanford, and the contractor.

Jet Drilling Co., Denver, is drilling for Barnes & Brown, Warren Petroleum Co., and H. E. Zoller, joint operators, at a rank wildcat location 6

L. F. Rojas (extreme left) is tool pusher on a rig Dunlap & Graham, Inc., Long Beach contracting firm, has working for Standard Oil Co. of California in Oxnard field, 60 miles west of Los Angeles, in Ventura County, California. With him are some of his crew: Left to right, E. L. Clay; H. H. Martin (driller); Ernest Lewis; and C. R. Vanbebber. Mark Wirlburn (not present) is derrick man in the crew.

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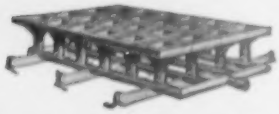

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miles northeast of De Nova, in eastern Washington County, eastern Colorado. The test is designated as 1 Claypool, with location in 3-2s-49w.

Krug Exploration & Drilling Co., Bakersfield, Calif., has taken on a well-deepening job near Hollister, in San Benito County, northern California. Deepening will be for Richard S. Rheem, who has taken over the test, 1 Jacques, in 20-12-5, drilled last year by Bell Petroleum Co. to 5,017 ft.

Justiss-Mears Drilling Co., Jena, La., has two rigs working for Nebo Oil Co., Inc., of Dallas, at outpost locations in the Nebo Hemphill area, in LaSalle Parish, Louisiana. One, 15 Nebo fee, in 20-7n-3e, is ¾ mile west of production. The other, 17 Nebo fee, in 7-7n-3e, is 2½ miles to the northwest and about a mile west of production. Both are 4,500-ft. Wilcox tests.

Cook Drilling Co., Fort Worth, has a new deep operation under way for Sunray Oil Corp. in the southern part of South Sarepta field, Bossier Parish, northwestern Louisiana. Location is at 1-B Antrim, in 34-22n-11w. It is a Cotton Valley-Ardis sand test.

Woolf & Magee, Tyler, Tex., will drill a Wilcox exploratory test for B. Serio, Punches Oil Co., and E. C. Wentworth, of Natchez, Miss., at 1 Harris, in 18-6n-9e, 2¾ miles southwest of Willetts, in Concordia Parish, eastern Louisiana.

R. W. Rine Drilling Co., Wichita, Kans., has a rig under contract to United Producing Co. for a 7,300-ft. Mississippian test at a wildcat location north of Mocane, in northern Beaver County, Oklahoma Panhandle. Location at 1 Evans, in 8-5n-25eCM, is 5 miles northwest of Knowles field, nearest production.

McGregor Drilling Co., El Dorado, Ark., has taken a contract for a rank wildcat test to be drilled for W. H. Lown, of Camden, Ark., in southwestern Jefferson County, Arkansas. Location, in 20-7s-10w, is west of Faith and about 9½ miles southwest of Pine Bluff, more than 60 miles from nearest production. A 3,500-ft. test is planned.

Milton Crow, Inc., Shreveport, La., has a new location to drill for Ralph Gilster and James E. Kemp in South Hallsville field, 10 miles southwest of Marshall in Harrison County, East Texas. It is to be a Pettit test with depth around 6,800 ft. Location is in the I. Van Zandt Survey, at 1 Martin.

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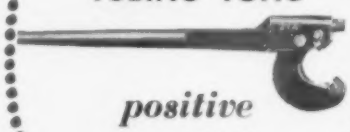

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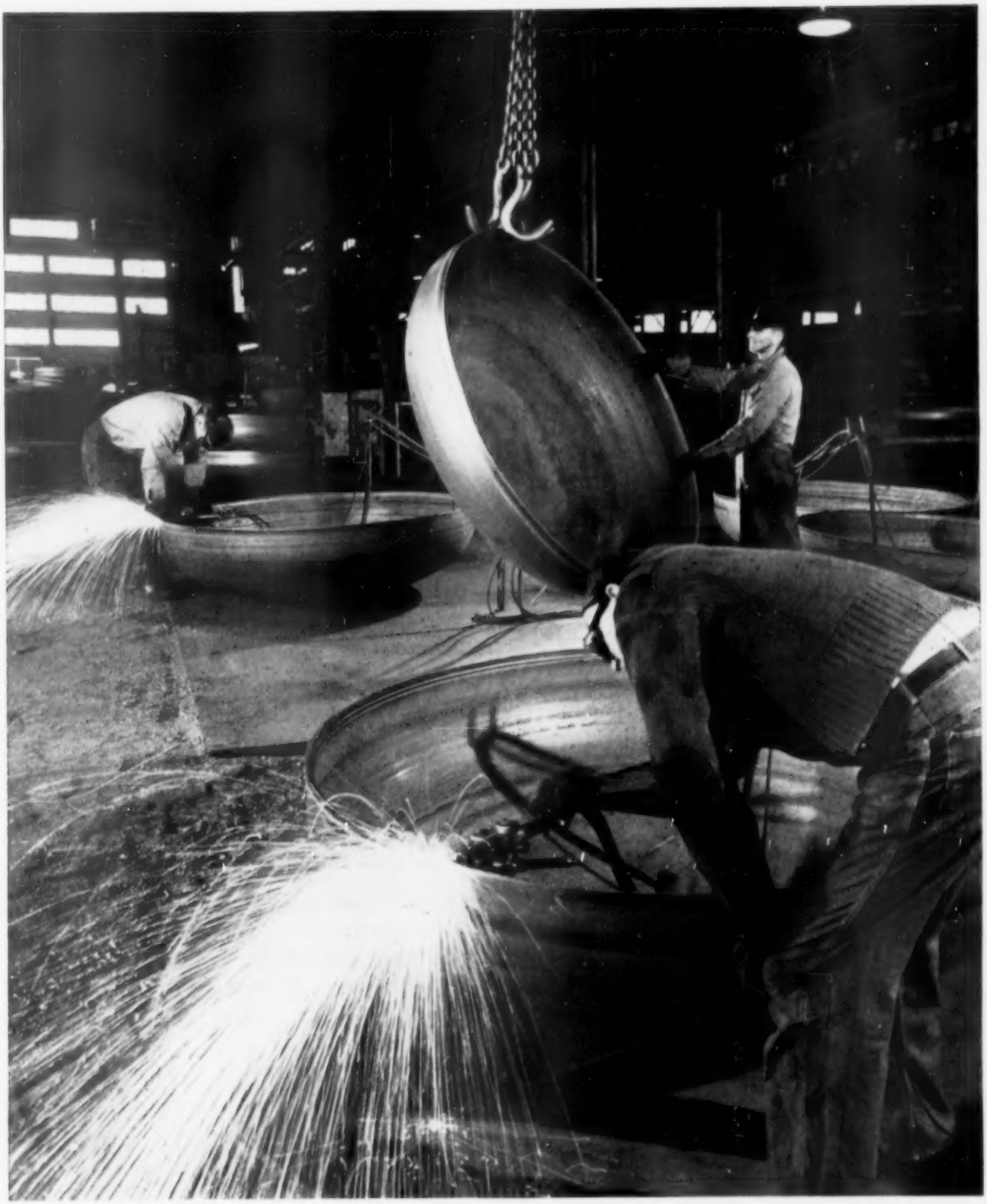

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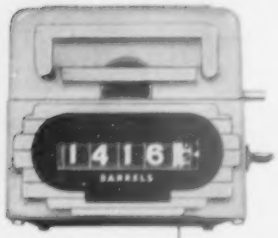

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PIPE LINE PROGRESS

Magnolia Pipe Line Company builds new 20-inch crude line with A. O. SMITH TEXAS-MADE LINE PIPE

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At Corsicana, oil from East Texas, Oklahoma, West Texas and New Mexico will be pumped into the new line. Ultimately, capacity of the line can be increased to 165,000 barrels per day with new pumping equipment.

All the line pipe for this new line is from the Houston mills of A. O. Smith and Sheffield Steel . . . 20-inch welded steel pipe that's accurate as to size, roundness and end-to-end matchup. We are proud to have been able to supply Magnolia Pipe Line Company Texas-made pipe for this all Texas line.

A. O. Smith Line Pipe is available in a complete range of sizes and wall thicknesses, from 8⅝-in. to 36-in. diameters.

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Fig. 522-C illustrated at left is furnished with bronze trim for use with steam, oil, water, gas, or chemicals which will not attack bronze. Fig. 522-C A.I., identical in construction but of all-iron, is supplied for use with caustic solutions, creosote oil, some acids, coal tar products, and many other fluids for which bronze cannot be used.

All castings used in these valves are of close-grain, hi-test gray iron, 50% stronger than ordinary iron, produced in R-P&C's own foundry. Their construction embodies quality features designed to insure long life, reduce maintenance. For example:

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U-bolt construction—Body and bonnet held rigidly together by heavy steel U-bolt which is easily removed and replaced when valve is disassembled—U-bolt held securely in place by three sets of lugs cast on body.

packing—Deep stuffing box packed with formed rings of special braided asbestos packing, lubricated and graphited. Positive backseat allows re-packing under full line pressure. Heavy deep packing nut gives proper application of pressure on gland.

wedge—Heavy, rugged wedge, slip-on type, is guided to proper setting by milled wide grooves which engage ribs cast in body. Wedge is reversible for longer life. When valve is wide open, wedge entirely clears line of flow for lowest possible pressure drop.

stem—Of high strength cold rolled steel or bronze rod stock. Inside screw construction. Stem rises as handle is turned for visual indication of position of wedge.

corrosion resistant—All iron and steel parts are Parkerized or Parcolac'd to impart corrosion resistance to both the interior and exterior of the valve.

Your R-P&C District Office or Distributor can give you complete information about this Fig. 522-C Clip Gate valve or any of the other valves in R-P&C's complete line—which includes bronze, iron, cast and forged steel, and bar stock valves. Call today or write for Catalog 9.

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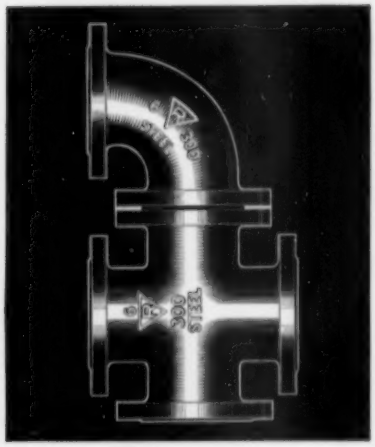
Bar stock valves are precision machined from highest quality bronze, carbon steel, or alloy steel bar stock. Working pressures for carbon steel range from 10,000 lbs. at 150°F to 475 lbs. at 1,000° F. Sizes from ⅛" to 1".



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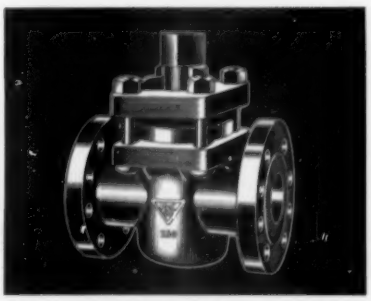
Before it leaves the factory, the performance of each valve is proved by individual hydrostatic and other tests. These tests are normally conducted at pressures higher than those for which the valves are rated.



Asbestos-packed cocks, an R-P&C exclusive, are furnished in iron in sizes from ¼" to 6" with screwed or flanged ends.

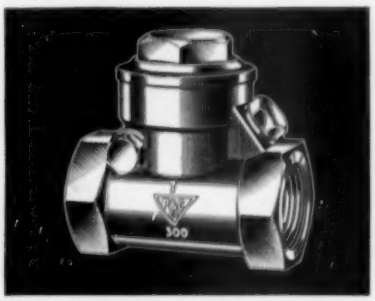


Fig. 212 screwed end bronze check valve typifies R-P&C's complete check valve line — furnished in iron, bronze or cast steel in sizes ranging from ¼" to 24".

WHICH OF THESE HELPFUL TECHNICAL AIDS DO YOU WANT?

R-P&C provides a wide variety of free technical aids to assist the buyer in valve selection, installation and operation. Among these are:

Valve Selector Slide Rule. Handy selector slide rule gives all dimensions for iron body valves, steel valves in 150, 300, 400, 600, 900 and 1500 lb. classes.

How To Select Valves. 17" by 11" wall chart lists principles to use in selecting valves for various applications . . . considers effects of fluids, temperatures, pressures, sizes, service requirements.

How To Protect Your Valves. 17" by 11" wall chart lists 22 installation and operation pointers to protect valves, get maximum life.

How To Know Valves. 17" x 11" wall chart graphically illustrates appearance, construction, operation, recommended applications for gate, globe and check valves, cocks.

Any of these free technical aids furnished promptly on request
Write R-P&C Valve Division, American Chain & Cable, Reading, Pennsylvania

ACCO

TRADE MARK

R-P&C Valve Division
AMERICAN CHAIN & CABLE

Reading, Pa., Atlanta, Boston, Chicago, Denver, Detroit, Houston, New York, Philadelphia, Pittsburgh, San Francisco, Bridgeport, Conn.

R-P&C valves

New

Take a closer look at what's required to make High Pressure Tubing to handle

30,000 psi

Pressures of 30,000 psi are accepted industrial practice today. They are not only representative of the advances in alloy tubing technology and manufacture, but also of the tremendous strides taken by the industries in which these elevated pressures are everyday working practice.

As pressures advance so must manufacturing techniques. For example, B&W was called upon recently to manufacture a special alloy tubing for polyethylene equipment based on Croloy 12 (AISI 410), to prevent product contamination. Special manufacturing and inspection techniques were involved in the production of the tubing which was cold finished to size. It was then heat-treated to obtain 100,000 psi yield strength, which could have been considerably higher except for the fact that toughness was desired to meet the dynamic service stresses encountered in operation. A sample of the tubing then was tested to 80,000 psi and, in order to force rupture at this pressure it was necessary to remove half of the wall thickness by machining. This destructive testing was made to insure satisfactory working conditions *at pressures of 30,000 psi.*

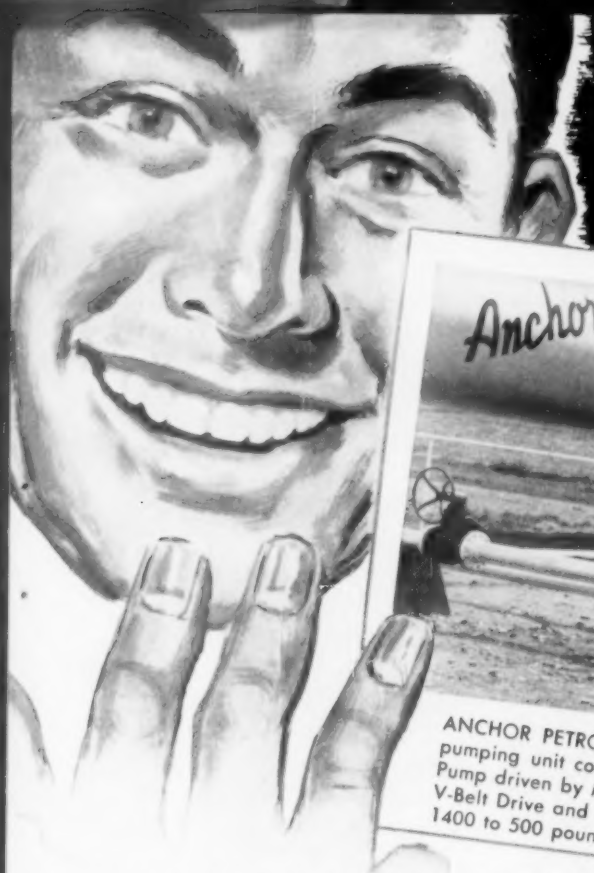
This example, while fulfilling the needs of a specific purpose, serves also to indicate the scope of techniques and facilities you'll find at B&W. Today, with laboratory testing of alloy tubing reaching 200,000 psi, the experience and knowledge of those called upon to make a test a *working reality* are of prime importance. You'll find both at B&W. Call on Mr. Tubes any time to help you meet your needs—standard as well as special.

THE BABCOCK & WILCOX COMPANY
TUBULAR PRODUCTS DIVISION
Beaver Falls, Pa.—Seamless Tubing; Welded Stainless Steel Tubing
Alliance, Ohio—Welded Carbon Steel Tubing

B&W SEAMLESS and WELDED TUBES

TA-4065(SSP)

GASO PUMP PERFORMS *TRIPLE SERVICE* IN 60,000 BARREL UNDERGROUND STORAGE PLANT



ANCHOR PETROLEUM'S UNDERGROUND STORAGE PLANT near Bath, N. Y. The pumping unit consists of a Fig. 1742 2½" x 5½" x 10" Gaso Duplex Piston Power Pump driven by Model 145-GKU Waukesha Power Unit, complete with steel skids, V-Belt Drive and Guard. Capacity from 38 GPM to 330 GPM at pressures from 1400 to 500 pounds.

The flexibility of Gaso Pumping Units is dramatically demonstrated in the installation pictured above, one of several operated by Anchor Petroleum Company:

1. In less than 90 days, operating in winter weather, the Gaso Pump washed out salt formation to give Anchor a 60,000-barrel underground storage reservoir.
2. Since then the pump has been storing gas in the cavity at a rate of 300 GPM.
3. The same pump will be used to displace the gas for consumers' use. Interchangeability of liners assures maximum efficiency on all jobs.

WE ARE PUMPING SPECIALISTS READY ALWAYS TO HELP YOU IN YOUR PUMPING PROBLEMS

GASO PUMP & BURNER MFG. CO.

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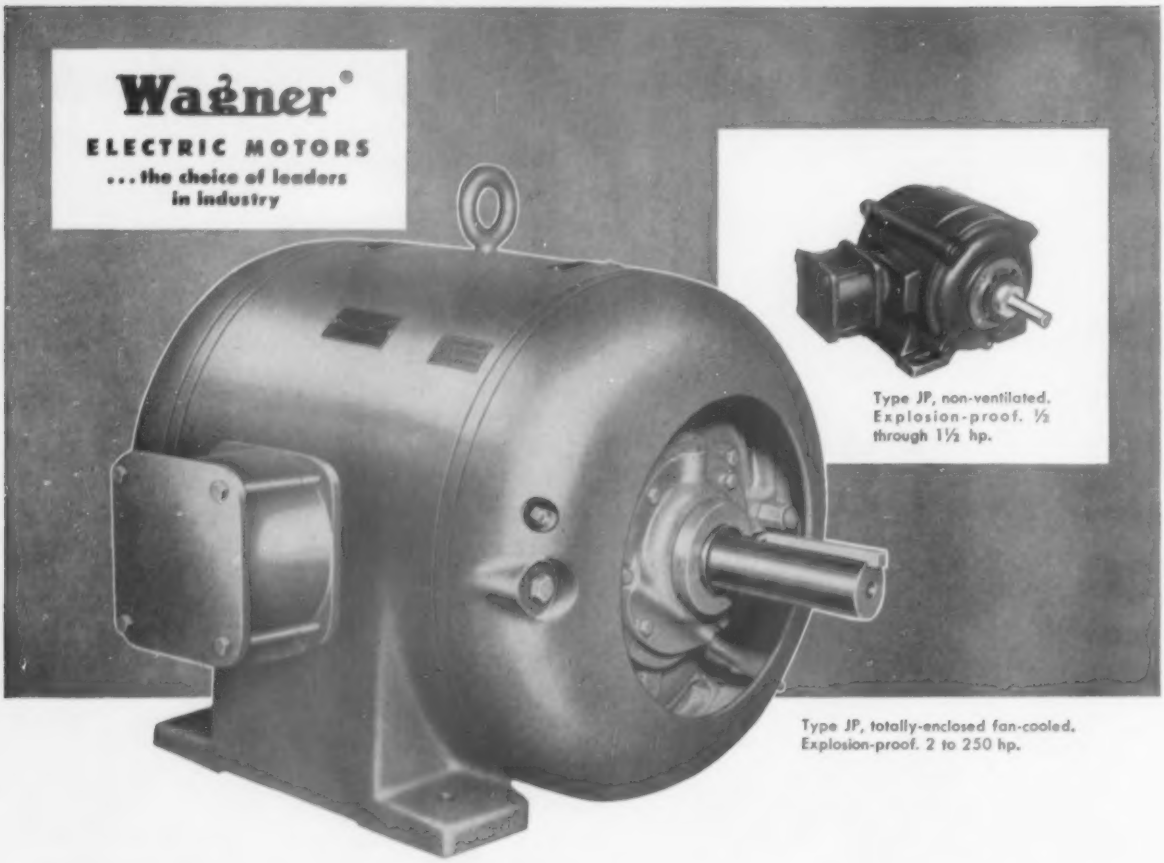
POWER PUMPS, INC., Long Beach, Calif.
PEDDLERS, INC., Houston, Texas
NORTEX ENGINE & EQUIPMENT CO., Wichita Falls, Texas
LUFKIN FOUNDRY & MACHINE CO., Casper, Wyoming

GASO PUMPS

for every oil industry need

Wagner®
ELECTRIC MOTORS
... the choice of leaders in industry



Type JP, non-ventilated. Explosion-proof. ½ through 1½ hp.

Type JP, totally-enclosed fan-cooled. Explosion-proof. 2 to 250 hp.

for extra protection against corrosion

SPECIFY Wagner CAST IRON FRAME MOTORS

Here are stock motors specifically designed for use in chemical plants, oil fields, refineries, steel mills—for rugged industrial applications where dust, dirt, moisture, or corrosive vapors are present.

These motors are totally-enclosed in corrosion-resistant cast iron and all parts exposed to the atmosphere are of corrosion-resistant material—including the nameplate. They feature completely protected laminations . . . special varnish treated windings . . . and a running shaft seal.

Wagner Cast Iron Frame Motors are available in fan-cooled standard and explosion-proof types in ratings from 2 to 250 hp, and in non-ventilated standard and explosion-proof types in ratings from ½ through 1½ hp. Wagner Bulletin MU-132 gives complete information.

A skilled Wagner engineer can help you select a Wagner Motor to meet your most exacting specifications. Call the nearest of our 32 branch offices, or write us.

Wagner Electric Corporation
EST. 1891

WAGNER ELECTRIC CORPORATION
6389 PLYMOUTH AVE., ST. LOUIS 14, MO., U.S.A.

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TRANSFORMERS
INDUSTRIAL BRAKES
AUTOMOTIVE BRAKE SYSTEMS—AIR AND HYDRAULIC

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As you read through the pages of The Oil and Gas Journal and you see products advertised on which you would like more information,

Ask us to get it for you

Just use the convenient pre-stamped cards on this page. We'll forward your requests promptly.

Mark here FOR MORE INFORMATION ON ADVERTISED PRODUCTS

Your inquiry will be forwarded to the supplier within 48 hours (or less) from the time we receive it.

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We'll get it for you

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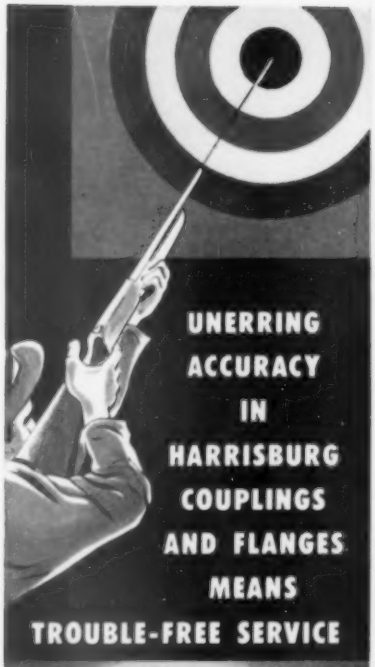
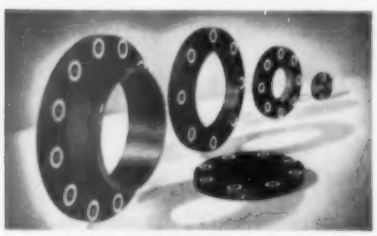


HARRISBURG SEAMLESS STEEL PIPE COUPLINGS
made to A.P.I. and A.I.S.I. specifications



HARRISBURG DROP-FORGED STEEL PIPE FLANGES
manufactured to A.S.A. standards

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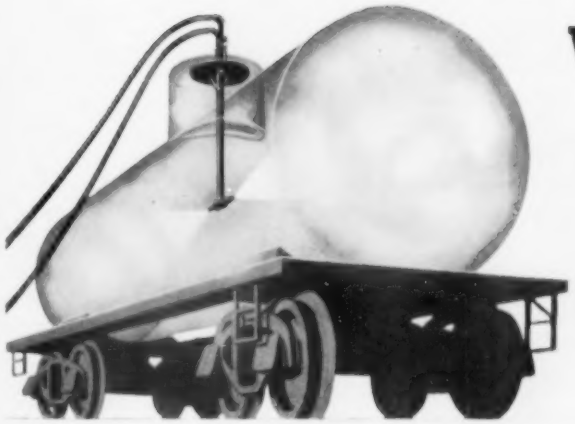
Henry H. Paris, Distributor, Inc.
TULSA
W. C. Norris, Manufacturer, Inc. (Couplings)
TULSA
Ardun Supply Company (Flanges)
HSC-PP-3/54

. . . OR WRITE DIRECT TO—

101 YEARS IN PENNSYLVANIA'S CAPITAL
Harrisburg Steel CORPORATION
HARRISBURG 6, PENNSYLVANIA

Fast Economical way to Clean Tank Cars



Drawing shows Fogging Unit in action, spraying car with detergent-saturated fog. Nozzle raises on telescoping tubes to clean dome.

You can cut tank car cleaning time by as much as 50% and detergent consumption by even more when you use this light weight, light duty Oakite Fogging Unit to clean your tank cars. Here's why:

1. It eliminates time-consuming pre-steaming. Cleans two cars completely in an 8 hour day where it previously took 48 hours to steam one incompletely.
2. It makes the most of your Oakite detergents with its saturating thoroughness. You'll use less material per car. One user cut his cleaning material costs by 74% with the Fogging Unit.
3. You'll get a more thorough job. Unit reaches all surfaces. Keeps hand-mucking to the minimum. Rinsing as well as cleaning is done through the unit making for more speed.
4. Unit weighs but 43 pounds. Is easily moved, set up.

The Oakite Fogging Unit is easy to operate, works wonders on light duty cleaning requirements. To operate, you simply insert the unit into the dome, clamp on, and introduce steam and suitable Oakite detergent. With steam and solution valves open, and car drains closed, you're ready to go. Nozzles spray detergent-saturated fog on all surfaces loosening soils and melting oils and residues.

The Oakite Fogging Unit may be rented at a nominal fee to users of Oakite cleaning compounds. Write today for more details. Oakite Products, Inc., 44C Rector Street, New York 6, N. Y.

SPECIALIZED INDUSTRIAL CLEANING
OAKITE
MATERIALS • METHODS • SERVICE

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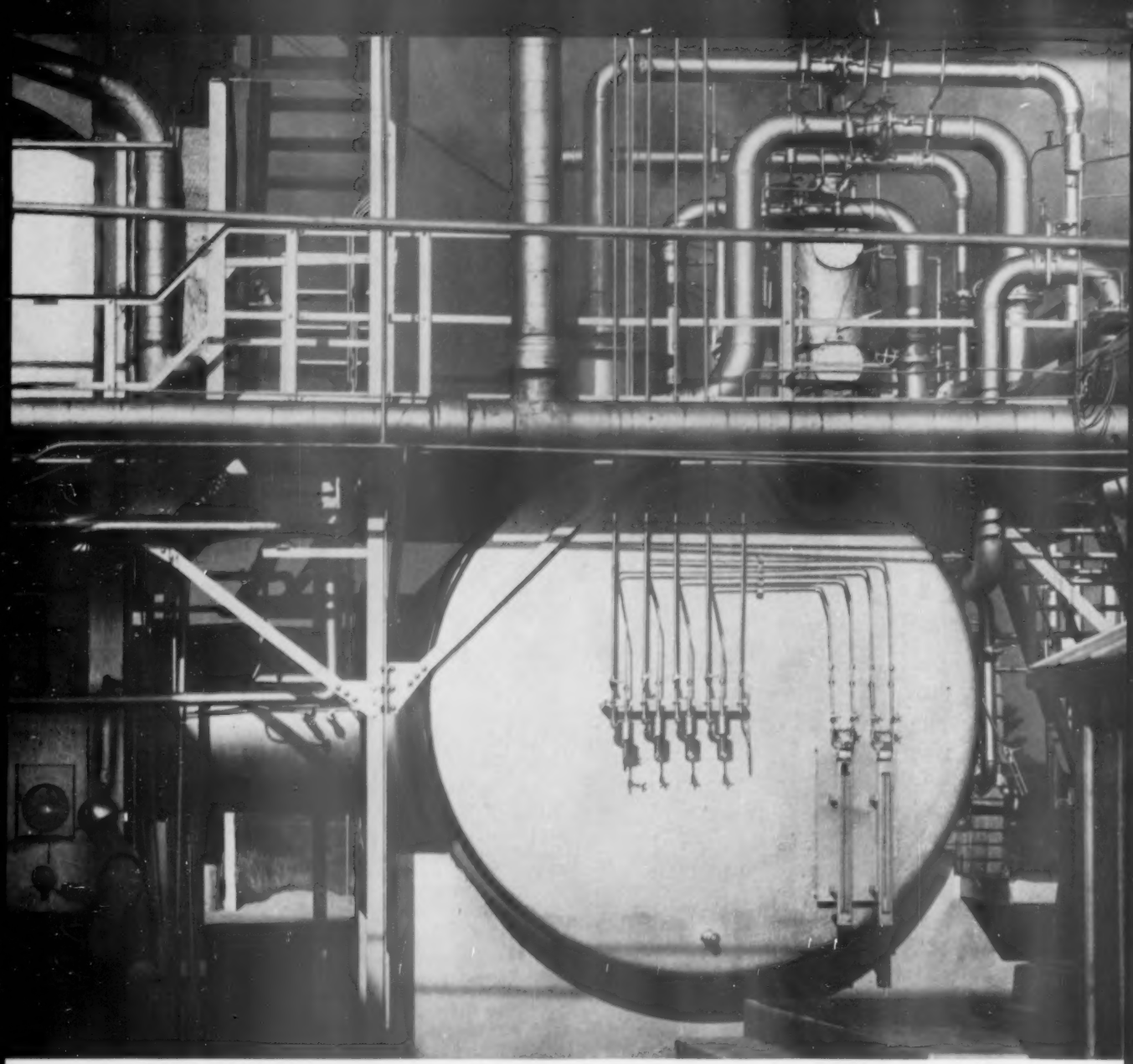

Mathieson Sulphuric: *meets the acid test*

Here, at one of the largest sulphuric acid units in the world, strict production control keeps the Mathieson product a standard of quality in the chemical industry. In this combustion chamber, elemental sulphur is burned to form sulphur dioxide which is reacted with oxygen and water to make sulphuric acid of high purity. This is one of seven Mathieson sulphuric acid plants, located in key industrial areas, that together produce an important part of the nation's fifteen million ton annual output.

Consistent product quality is typical of all Mathieson chemicals. In addition, Mathieson offers consumers the protection of multi-plant production facilities . . . 3 major alkali plants, 5 chlorine plants, 3 ammonia plants . . . as well as practical technical assistance with chemical handling and application problems.

In planning your chemical requirements call in your Mathieson representative. Perhaps you can buy to better advantage from one of America's largest producers of basic industrial chemicals.

OLIN MATHIESON CHEMICAL CORPORATION

MATHIESON

INDUSTRIAL CHEMICALS DIVISION

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CAUSTIC SODA • SODA ASH • CHLORINE • SULPHURIC ACID • SULPHUR • AMMONIA • NITRATE OF SODA • BICARBONATE OF SODA • NITRIC ACID • SULPHATE OF ALUMINA • SODIUM CHLORITE PRODUCTS
ETHYLENE OXIDE • ETHYLENE GLYCOL • DIETHYLENE GLYCOL • TRIETHYLENE GLYCOL • POLYGLYCOLS • DICHLOROETHYLETHER • ETHYLENE DICHLORIDE • METHANOL • SODIUM METHYLATE • ETHYLENE DIAMINE

CUT THE COST OF HANDLING CRUDE

...by metering direct from pipeline to refinery

A. O. Smith B-200 Meters are in 'round-the-clock service metering crude directly from pipeline to refinery. Meters are equipped with automatic temperature compensator and dual ticket printer with shifters to furnish accurate printed records. The B-200 has a maximum rated capacity of 3,000 barrels per hour.

Through research A.O. Smith *...a better way*

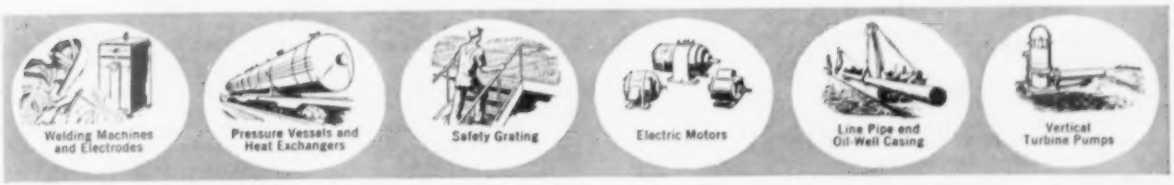
A.O.Smith
CORPORATION

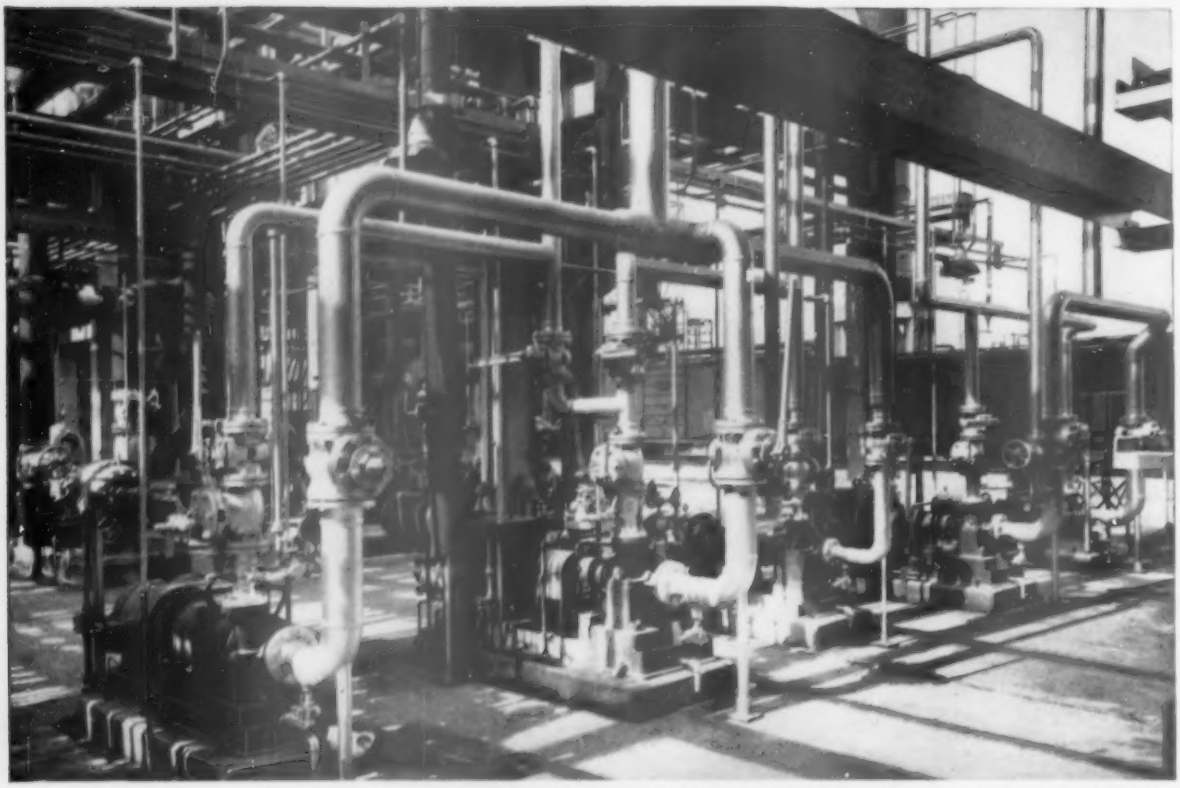
METER DIVISION

Factories: 5715 Smithway St., Los Angeles 22, Calif., P. O. Box 500, Succasunna, N. J. Offices: Atlanta, Chicago 7, Houston 20, Los Angeles 22, New York 17. Canada: Toronto 12, Vancouver 1. International Division—Milwaukee 1, Wis.

Here's a better, lower-cost way to transfer ownership of crude from pipeline to refinery. Do it *directly* with A. O. Smith Meters. You save heavy investment in real estate, gaging expense of storage tanks, avoid vapor losses and obtain more accurate control.

See nearest representative for complete information.





FORTY-FIVE WORTHINGTON HEAVY-DUTY HM PUMPS are on the job at Sinclair's new Houston refinery. Five of the HM's are shown in the foreground of the photograph.

Sinclair selects Worthington HM heavy-duty process pumps

Forty-five HM pumps are operating continuously on crude distillation and cracking service at Sinclair Oil's Houston, Texas, refinery.

These features built into the Worthington HM help give this heavy-duty line long life, lower maintenance, and day-in, day-out reliability.

1. Centerline support, water-cooled stuffing box and bearings for efficient high temperature operation.
2. Worthington's special mechanical seals for the higher pressures.
3. Confined casing gaskets and hook-type hardened stainless steel shaft sleeves.

And because the HM is an end suction pump, piping is simplified and there's no interference of valving in suction and discharge lines.

Find out more about this heavy-duty Worthington pump available in carbon steel, alloy steels, and cast iron. Write for free Bulletin, W-341-B14, to Worthington Corporation, Centrifugal Pump Division, Harrison, New Jersey. C.4.8

WORTHINGTON

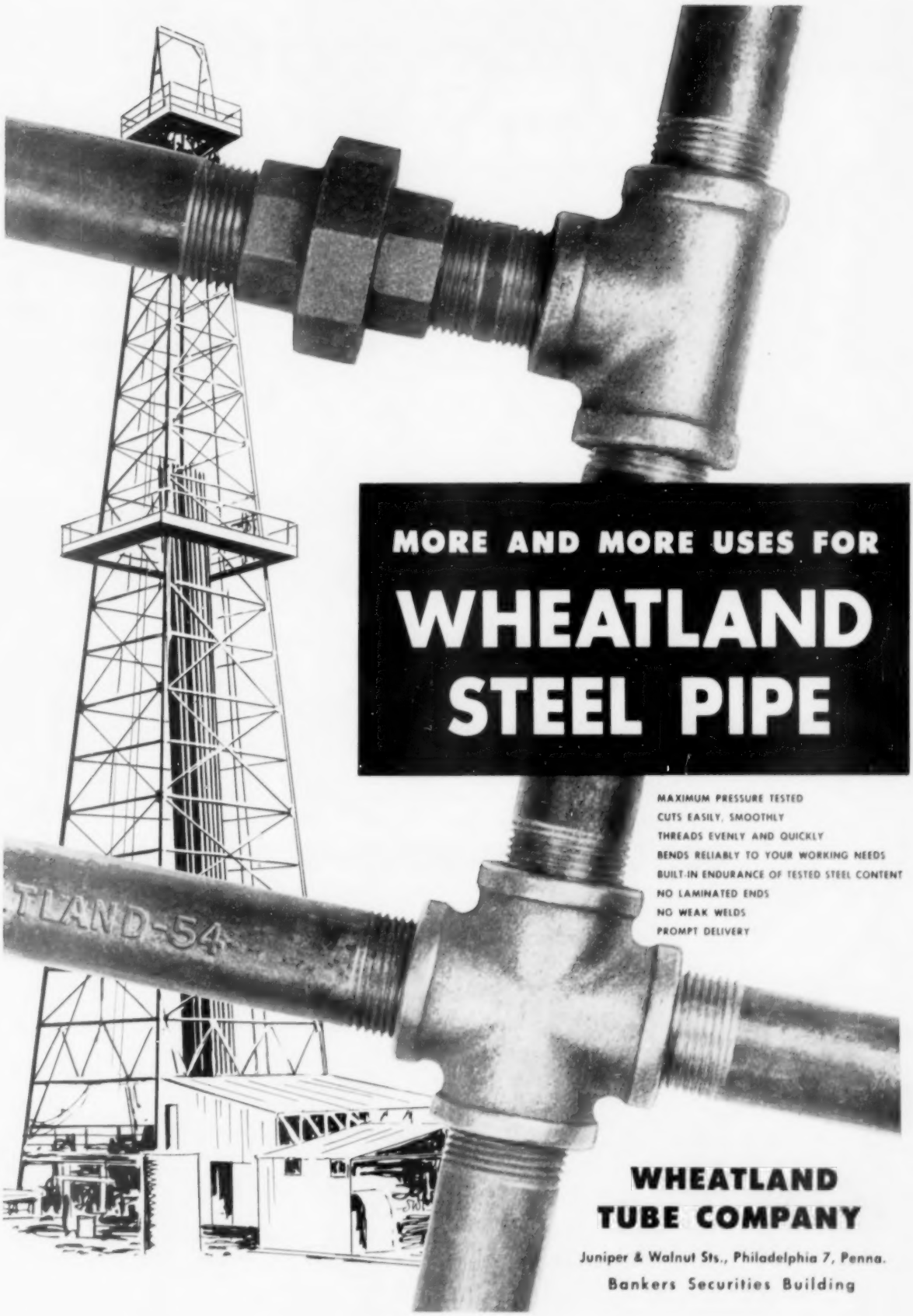
THE WORLD'S BROADEST LINE ASSURES YOU THE RIGHT PUMP FOR EVERY JOB

Types HR and HB. 19 sizes. Capacities up to 1,800 gpm. Developed heads up to 900 ft. Proper selection of materials permits use for temperatures far below zero to 800 F, for pressures from high vacuum to 750 psig.

Type CNE. For loading or transfer service. Capacities to 2,700 gpm. Heads to 500 ft.

Type HM. Available in 12 sizes. Capacities to 700 gpm. Heads to 475 ft. Up to 500 F.

Type HD. Hydraulically balanced double-suction impeller handles boiling liquids with low submergence. Capacities range from 600 to 3,200 gpm at heads up to 700 ft. To 850 F and 550 psig.



MORE AND MORE USES FOR

WHEATLAND STEEL PIPE

MAXIMUM PRESSURE TESTED
CUTS EASILY, SMOOTHLY
THREADS EVENLY AND QUICKLY
BENDS RELIABLY TO YOUR WORKING NEEDS
BUILT-IN ENDURANCE OF TESTED STEEL CONTENT
NO LAMINATED ENDS
NO WEAK WELDS
PROMPT DELIVERY

WHEATLAND TUBE COMPANY

Juniper & Walnut Sts., Philadelphia 7, Penna.
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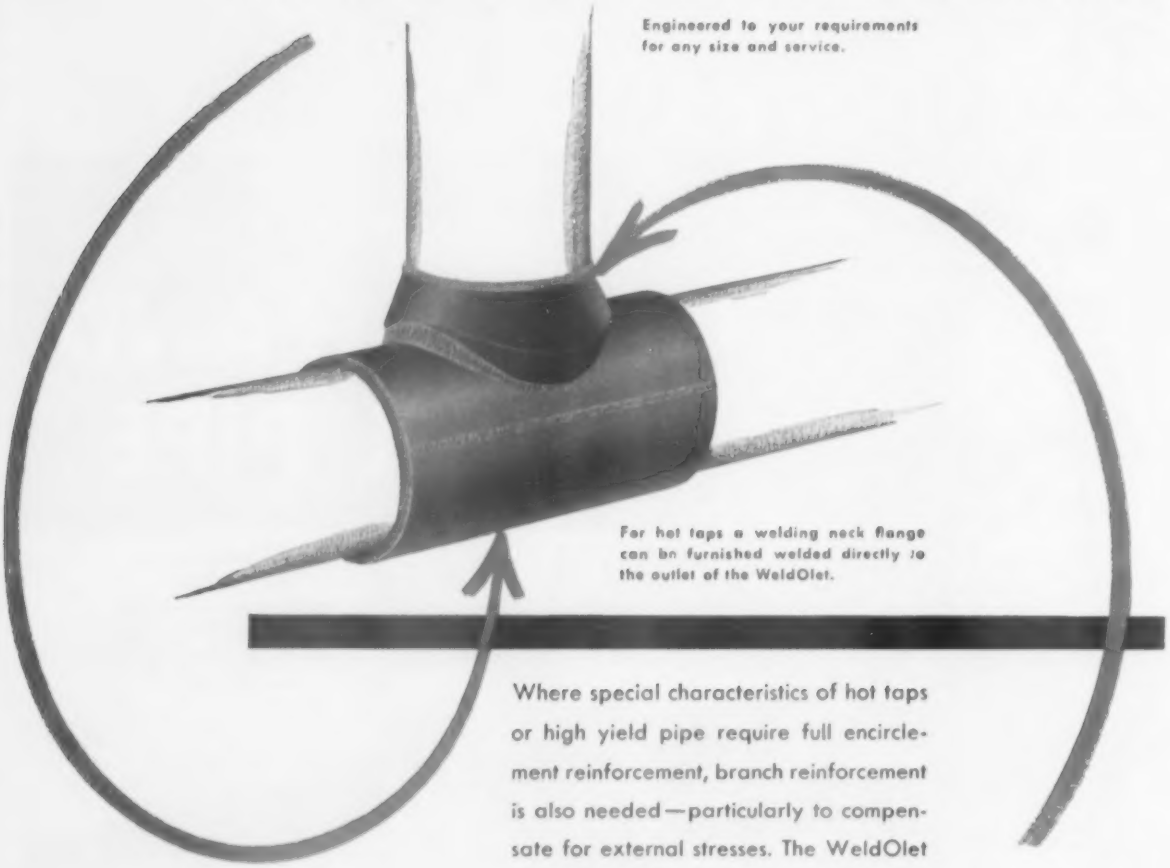
announcing BONNEY'S

New WeldOlet Split Tee for hot taps and new construction

Assembled and Ready for Field Installation, the WeldOlet Split Tee "Nails Down The Lid" where Full Encirclement Reinforcing is Needed.



Engineered to your requirements for any size and service.

For hot taps a welding neck flange can be furnished welded directly to the outlet of the WeldOlet.

Where special characteristics of hot taps or high yield pipe require full encirclement reinforcement, branch reinforcement is also needed—particularly to compensate for external stresses. The WeldOlet Split Tee satisfies this combined requirement in the most economical manner.

Write or phone today for general information or about your specific requirements.

BONNEY FORGE & TOOL WORKS

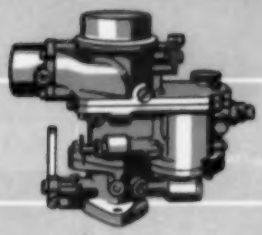
WELDING FITTINGS DIVISION

ENG. DEPT., 366 GREEN ST., ALLENTOWN, PENNA.

ENSIGN

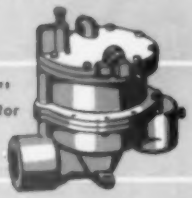
Model "Kg1"
Gas Carburetor

Model "Kgn1"
Combination Carburetor



Model "Cg"
Combination Carburetor

Model "F"
Regulator

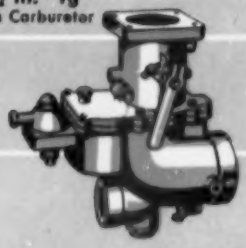


Model "B"
1 in. Regulator

Model "G1"
Gas Carburetor

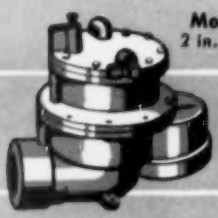
Number 6257
Liquid LP-Gas Filter

Model 2½ in. "Tg"
Combination Carburetor



Model "R" 125 H.P.
LPG Vaporizer & Regulator

Model "A"
Gas Carburetor



Model "B"
2 in. Regulator

Model ¾ in. "Tg"
Combination Carburetor

Model "W" 55 H.P.
LPG Vaporizer & Regulator

Model "Xg"
Gas Carburetor

Model "5" 450 H.P.
LPG Vaporizer & Regulator

Model "Dg"
Gas Carburetor

Model "HD" 450 H.P.
Vaporizer

Complete line of Natural Gas and Propane Carburetion.

5 TO 500 HORSEPOWER

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CARBURETOR COMPANY

Huntington Park, Calif. • Chicago 36, Ill.

LORAINS on rubber...

GO PLACES—
GET THINGS DONE—
FAST—
AROUND REFINERIES!

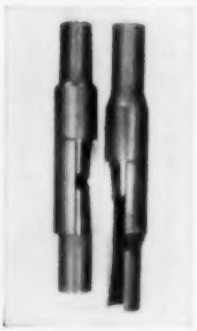
To get around quickly — to get jobs done in a hurry, why not apply the modern Lorain rubber-tire crane method to *your* refinery operations? Here are 4 big-name oil companies that find important savings and economies — with Lorain rubber-tire Cranes. These versatile Lorains lift and load material and equipment of all kinds — can excavate and erect — handle still and condenser maintenance . . . and roll quickly on rubber to wherever the job is. They are available in capacities of from 6 to 45 tons, can handle a wide variety of materials — from sand to steel. 4 or 6 wheel drive arrangements on Self-Propelled or Moto-Crane types can be fitted to travel conditions. When you are ready "to go places", ask your Thew-Lorain Distributor to show you the way with a Lorain on rubber tires!

THE THEW SHOVEL CO., LORAIN, OHIO

OIL MEN PREFER THE NAME THEW LORAIN

SHOVELS • CRANES • DRAGLINES
CLAMSHELLS • HOES

SHEFFIELD ARMCO® Alloy Steel



Produced In A Full Range Of AISI Grades To Meet Virtually All Manufacturing Requirements

Tonnage-wise, Sheffield's steel producing capacity has been stepped up many times.

So has the range of grades in which Sheffield steels are made. These include the full range of standard AISI alloy steels. It is estimated that these meet up to 95% of requirements of manufacturers in the heavy hard goods field.

New annealing and heat treating facilities further widen the levels of strength, or hardness in which Sheffield alloy steels are supplied. Also the range of shapes and sizes is constantly being broadened for more varied engineering application.

In order to insure that their chemical and physical ranges fall within close limits, Sheffield alloys are electronically checked with a direct reading quantometer. It is capable of simultaneously determining the quantities of eight different alloy elements in a matter of minutes.

Pictured above are some of the products which manufacturers make from Sheffield alloy steel. Sheffield offers to all manufacturers, engineering and research organizations the services of its metallurgical and engineering staff in developing steels to fit individual and particular requirements.

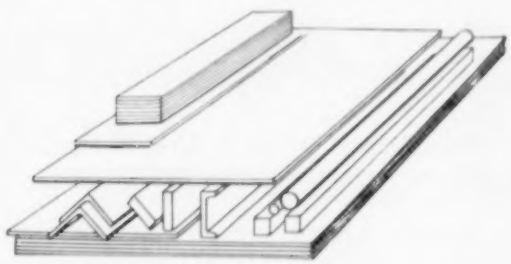
Write or call your nearest mill or district sales office if you have steel problems involving strength, hardness and corrosion or abrasive resistance which alloys impart.

SHEFFIELD STEEL

DIVISION

ARMCO STEEL CORPORATION

SHEFFIELD PLANTS: HOUSTON KANSAS CITY TULSA



the Sky's the Limit with SUPERIOR HEAT EXCHANGERS

Unlimited engineering facilities plus an adequate plant and equipment, make the sky the limit on Superior Combustion Industries' ability to design and fabricate heat exchangers for the most unusual conditions. Those shown here, designed for gas-to-gas heating, are 40 ft. high and 40" in diameter.

Our engineering staff invites your inquiry regarding any proposed installation . . . as a basis for a specific engineering recommendation.

For details of construction, write today for fully illustrated Catalog 6011.

for performance you can **BANK** *on*

SUPERIOR COMBUSTION INDUSTRIES INC.
TIMES TOWER, TIMES SQUARE, NEW YORK 36, N.Y.

SUPERIOR HEAT EXCHANGERS

Our Face is Red!

We never dreamed . . . that the oil industry would respond so enthusiastically to our introduction of the "Royal Scintillator." We were caught with our production down. We not only did not have enough instruments to supply the demand, we didn't even have enough catalogs. We apologize and wish to assure our customers that we are now in a position to give prompt service.

Not everyone agrees that the radiation survey technique is a proven method of oil field exploration. We agree that not enough data is available as yet, however, there is a growing body of opinion which holds that this is a valuable technique. Recent very encouraging results support this opinion.

We cannot guarantee that the Model 118 Royal Scintillator will locate oil, but we can guarantee that the Royal is the best instrument made for investigating the radiation pattern existing around oil fields. It is also the best instrument made for uranium prospecting, and its use for this purpose should not be overlooked by oil geologists.

Write now for our free pamphlet on "The Principles of Oil Field Detection with Scintillation Counters" and our complete catalog on Geiger Counters and Scintillation Counters.

PRECISION RADIATION INSTRUMENTS, INC.

2235 OG S. LA BREA AVE., LOS ANGELES 16, CALIFORNIA

Name _____ Title _____

Company _____

Address _____ City _____ State _____

PRECISION RADIATION INSTRUMENTS, INC.

World's Largest Manufacturers of Portable Radiation Instruments

This is Why the Nash is the Most Simple Compressor

It's the Nash!

There are no mechanical complications in a Nash Compressor. A single moving element, a round rotor, with shrouded blades, forming a series of buckets, revolves freely in an elliptical casing containing any low viscosity liquid. This liquid, carried with the rotor, follows the elliptical contour of the casing.

The moving liquid therefore recedes from the rotor buckets at the wide part of the ellipse, permitting the buckets to fill with gas from the stationary Inlet Ports. As the casing narrows, the liquid is forced back into the rotor buckets, compressing the gas, and delivering it through the fixed Outlet Ports.

Nash Compressors produce 75 lbs pressure in a single stage, with capacities to 6 million cu. ft. per day in a single structure. Since compression is secured by an entirely different principle, gas pumping problems difficult with ordinary pumps are often handled easily in a Nash.

Nash simplicity means low maintenance cost, with original pump performance constant over long periods. Data on these pumps sent immediately on request

No internal wearing parts.

No valves, pistons, or vanes.

No internal lubrication.

Low maintenance cost.

Saves floor space.

Desired delivery temperature automatically maintained.

Slugs of liquid entering pump will do no harm.

75 pounds in a single stage.

NASH ENGINEERING COMPANY

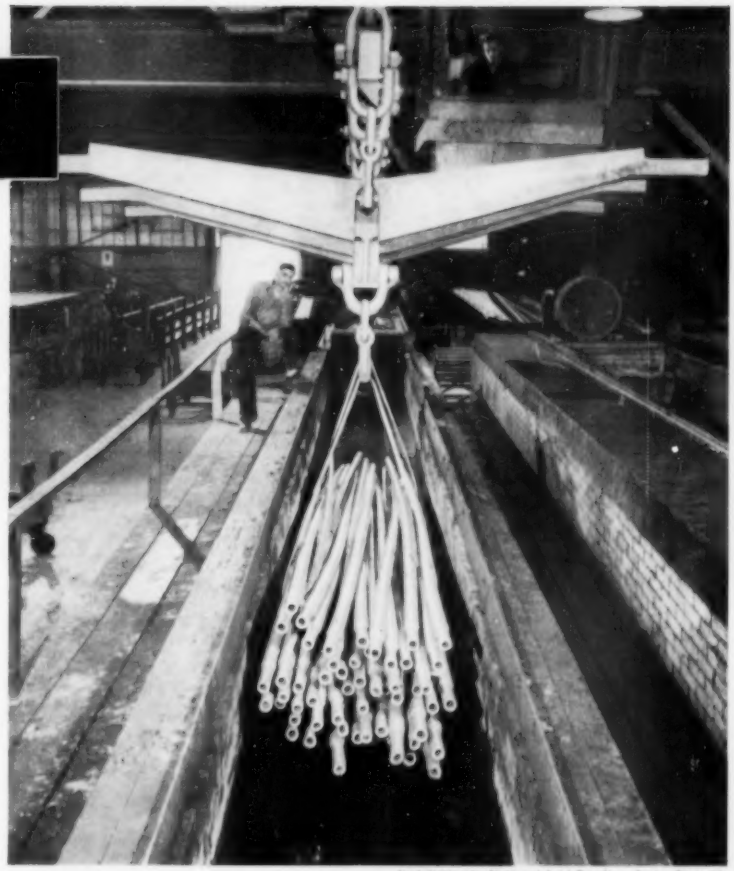
313 WILSON, SO. NORWALK, CONN.

Industry wipes out corrosion with Firestone Exon Resins

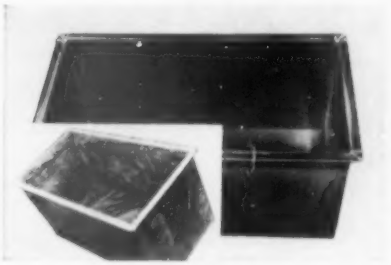
LINED WITH VYFLEX L-10*

TANKS WIN EVERY BATTLE AGAINST CORROSION

Corrosion costs kept pyramiding at the Globe Steel Tubes Co., Milwaukee, Wisconsin. At temperatures of 80° to 90°, solutions of 20% nitric acid-hydrofluoric acid quickly ruined each type of costly lining tried in the 47-foot "pickling tank." After exhaustive tests of every available material, Globe engineers finally hit upon Vyflex L-10* made from Exon 900 series resins. This durable vinyl lining ended their corrosion problem. Installation was quick, simple and less costly than the linings previously used. Subsequent maintenance and replacement costs have been eliminated!

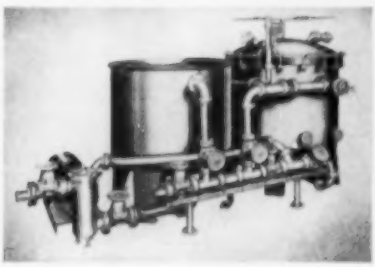


Installation by National Acid Proofing, Tinley Park, Ill.



★ Corrosive chromic acid plating solutions destroyed in 6 months protective surface applied at the Tripp Plating Co., Buffalo. At 150° operating temperature, the acid has yet to affect tanks since they were lined with Vyflex L-10*.

Installation by Metal Cladding Inc., Buffalo, N. Y.



★ Standard 4200 G.P.H. chrome plating solution filter with Vyflex L-10* linings, made by Industrial Filter & Pump Mfg. Co., of Chicago. This leading filter manufacturer selected Vyflex L-10* linings as part of the original construction for this unit.

★ At Hoffmann-LaRoche Plant in Nutley, N. J., Vyflex L-10's* versatility permitted *on the spot* relining, without dismantling the huge 6′ x 6′ x 10′ bleach tanks. Thus, installation costs and "down" time were greatly reduced.

Installation by La Favorite Linings, Inc., Hawthorne, N. J.

*Vyflex L-10, made from EXON 900 series resins is a product of Kaysor Industries, Inc. Division of Kaye-Tex Mfg. Corp. Yardville, New Jersey.

Firestone EXON

The simple fact is: you can stop corrosion. The tank liners shown above are based on only one of the many Exon resins developed by Firestone engineers to answer corrosion problems.

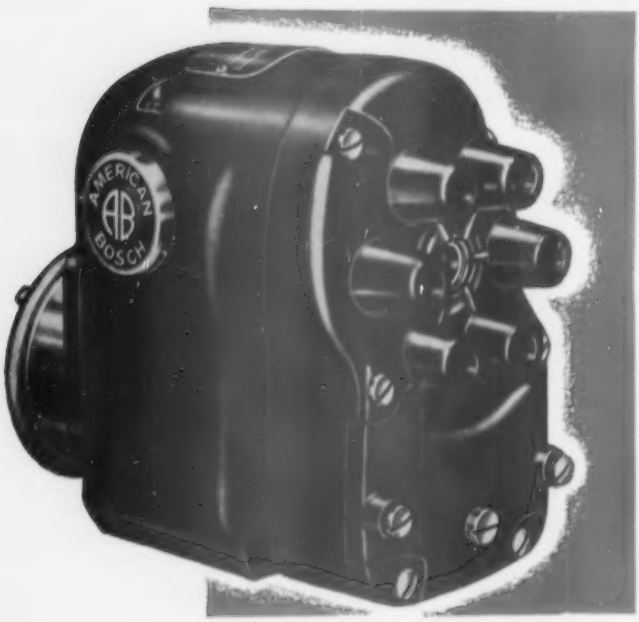
Exon polyvinyl chloride resins are the bases for a wide variety of corrosion controlling materials. In the form of lightweight structural rigids, linings or coatings, these versatile P.V.C. materials have a wide range of properties, providing the answer to your specific corrosion problem.

For details that will interest you in particular, call or write:

Chemical Sales Division
FIRESTONE PLASTICS COMPANY, DEPT. 24C, POTTSTOWN, PENNSYLVANIA
A DIVISION OF THE FIRESTONE TIRE & RUBBER CO.

NOTE: Firestone supplies the resin only, does not manufacture the end product.

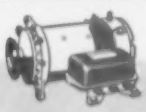
There's an American Bosch Magneto precisely engineered for ALL your replacement needs . . . for the largest, spark ignited, heavy duty engines with high or low tension ignition, right down to the Magnetos required for modern, high speed power units. In countless engine applications, these power-packed Magnetos have proved they are *better to start with and best in the long run* for drilling, producing, pipeline and refinery equipment. From starting time measured in split second response to trouble-free ignition measured in years of service, these rugged Magnetos provide the constant, faultless spark that spells maximum efficiency at all operating speeds and loads. These are the obvious reasons American Bosch Magnetos have been in wide use for so many years as original equipment for many leading engine builders.



Write today for Magneto application data on your low or high tension ignition engines. We'll give you the name of a nearby AB Service Agency, a part of one of the most wide-spread and efficient Magneto service facilities in the world. American Bosch, Springfield 7, Massachusetts.

AMERICAN BOSCH

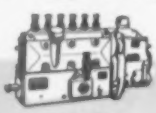
Automotive and Aviation Magnetos


Generators and Regulators

Components for Aircraft Engines

Electric Wipers and Small Motors

Ignition Coils


Diesel Fuel Injection Equipment

Demonstration shows Rockwood FogFOAM SPOT Protection extinguishing gasoline fire.

How to quench a sudden flareup

Don't give danger "spots" a chance to wreck you! Give them the kind of coverage shown in the demonstration above. Here, a gasoline-filled pit was set on fire — and extinguished in a matter of seconds by a Rockwood *Spot Protection System* discharging Rockwood FogFOAM. This FogFOAM also provided fire protection to the surrounding area by covering the edges of the pit.

Rockwood FogFOAM is formed by mixing 3 parts Rockwood Double Strength FOAM with 97 parts water — then discharging it through specially engineered FogFOAM heads or nozzles. A protein type liquid, it is used in spot protection systems and also in fire hose lines by being discharged through the Rockwood Type SG-60 Nozzle or Type FFF Nozzle. The Type SG-60 Nozzle discharges high velocity FogFOAM, solid FOAM stream (through an Extension FOAM Shaper) and, when FOAM is shut off, high velocity WaterFOG, low velocity WaterFOG or straight water stream. For ¾", 1" and 1½" fire hose lines.

Put these firefighters to work for you.

ROCKWOOD SPRINKLER COMPANY

Engineers Water . . . to Cut Fire Losses

Rockwood Double Strength Foam clings to metal surfaces as an insulator, flows freely at sub-zero temperatures. Excellent for extinguishing fires in gasoline, benzol and other highly volatile flammable liquids as well as ordinary combustibles.

Rockwood Wet makes water go farther. One part of Wet mixed with 99 parts water, increases penetration and extinguishing action of water. A "must" for deep seated fires and where water is scarce. Helps reduce amount of time and manpower.

SEND FOR THIS INFORMATIVE BOOKLET

ROCKWOOD SPRINKLER COMPANY
Portable Fire Protection Division
369 Harlow Street
Worcester 5, Mass.

Please send me your illustrated booklet on Rockwood fire-fighting products.

Name .....

Title .....

Company .....

Street ..... City .....

Zone ..... State .....

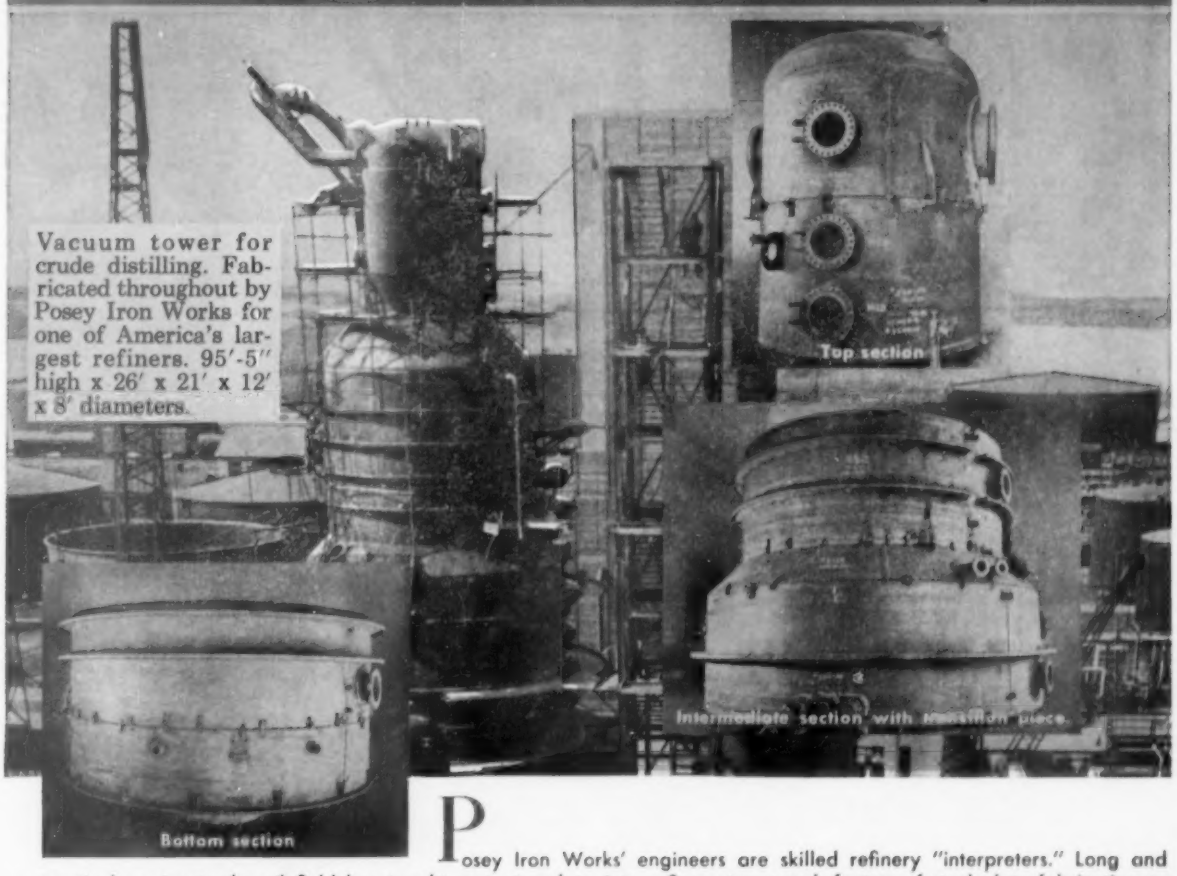
Dig 'em and fill 'em with CLEVELANDS

THE CLEVELAND TRENCHER COMPANY
20100 St. Clair Avenue • Cleveland 17, Ohio

THEY'RE *Good* *Everywhere*

SECTIONAL CONSTRUCTION:

Posey Knows It Inside and Out ... and From the Oil Man's Viewpoint



Vacuum tower for crude distilling. Fabricated throughout by Posey Iron Works for one of America's largest refiners. 95′-5″ high x 26′ x 21′ x 12′ x 8′ diameters.

Posey Iron Works' engineers are skilled refinery "interpreters." Long and practical service to the oil field has taught us to translate into *refinery* terms such factors of steel plate fabrication as sectional construction . . . loads . . . pressures . . . capacities . . . fire protection requirements . . . steels . . . alloys . . . and specialized structures.

All Posey Iron tanks and vessels are tested to a considerable excess over working pressures. Products are designed and built to comply with the requirements of the ASME; API-ASME; API and other codes. The Posey Iron Works is authorized to apply the appropriate code symbols.

Talk over your steel and alloy steel plate fabrication needs with Posey Iron. You'll find we talk your language.

AND STEEL AND ALLOY STEEL PLATE FABRICATION

POSEY IRON WORKS, INC.

Steel Plate Division

LANCASTER, PA.

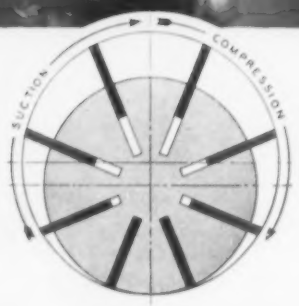
New York Office: Graybar Building

ESTABLISHED SINCE 1910

DIVISIONS
Brick Machinery
Foundry
Industrial Heating
Iroquois
Shipbuilding
Steel Plate

Two Fuller rotary two-stage gas boosters, each handling 1,500,000 SCFD, with atmospheric inlet pressure, or 2,500,000 SCFD, 10 psig. inlet pressure can be handled compressing to 70 psig. discharge, electric motor drive.

Three Fuller rotary single-stage natural gas boosters, capacity each 1,430,000 cu. ft./24 hrs. from 5-lb. to 25-lb. gage, driven by Climax gas engine.



BOOSTING GAS?
with FULLER rotary compressors
IT NEED NOT BE COSTLY

Fuller Rotary Compressors for booster service have many advantages that warrant your closest examination, whether for field boosting or to trunk-line levels. You'll find these units do a better job . . . better because they reduce maintenance cost, cut inspection time, last longer, do the job efficiently.

They're sturdy, dependable, because they have a minimum of moving parts—rotor, bearings, blades—requiring minimum attention. No valves to leak, no seats to grind; blades automatically compensate for wear, *maintaining capacities for the life of the machines.*

No detail has been overlooked that will make for long-term, trouble-free service, at the lowest maintenance and operating cost. These features explain why Fuller boosters do an outstanding job wherever gas is handled. For detailed information on Fuller Rotary Compressors, that will do a better job for you, write for Bulletin C-5A.

FULLER COMPANY—CATASAUQUA, PA.

Branch offices

Chicago—San Francisco—Los Angeles—Seattle—Birmingham

Fuller

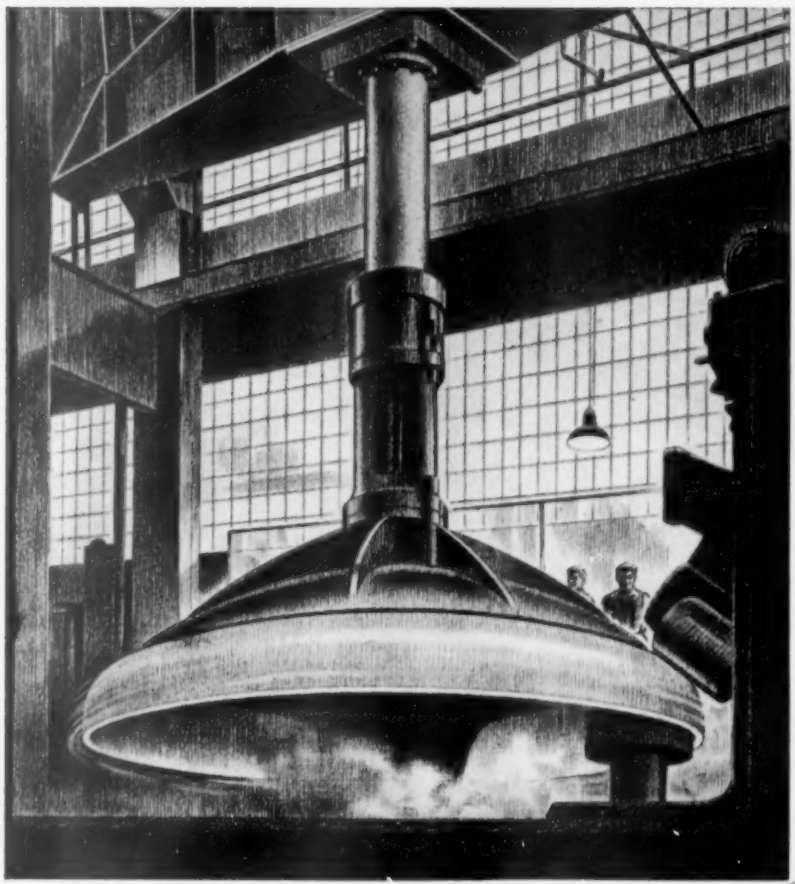
PIONEERS OF HIGH-EFFICIENCY VANE-TYPE ROTARY COMPRESSORS

C-238
2155

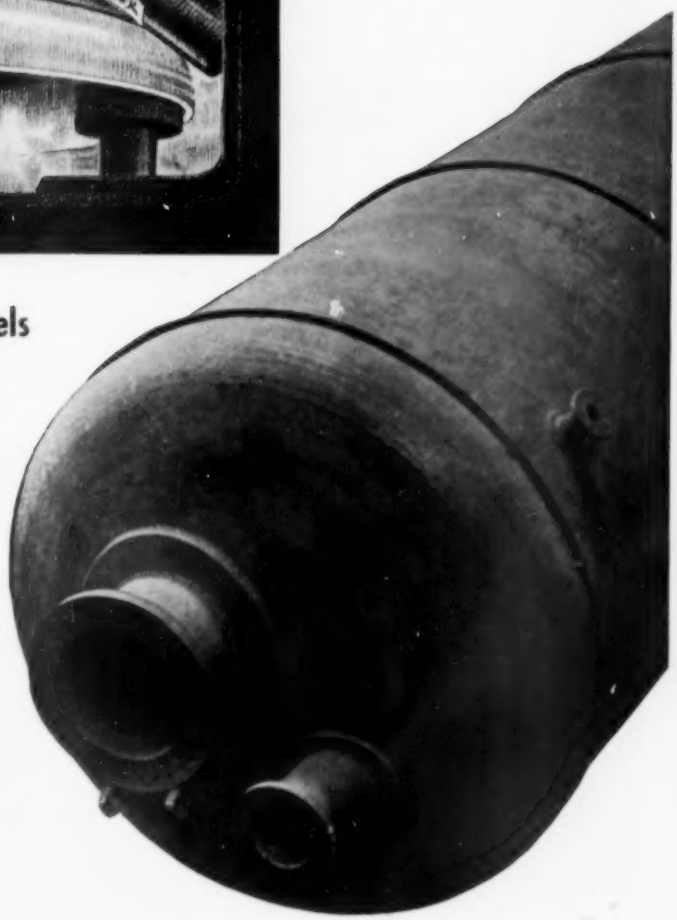
Spinning

SAVES METAL

—CUTS TOOL COSTS



The design and production of Pressure Vessels may be greatly facilitated by using dished and flanged ends spun by Harveys on the Rotarpress. They combine semi-ellipsoidal form with large knuckle radius. A substantial reduction in plate thickness can be effected, and in most cases tool costs are eliminated.



'Rotarprest' Ends for Pressure Vessels

can be supplied in Mild, Alloy and Clad Steels and Non-ferrous Metals. The capacity of the Rotarpress ranges from 5 to 15 feet diameter, and $\frac{1}{8}$" to 4" thickness. Knuckle radii and depth may be varied to meet individual requirements.

Please ask for List No. OG-881 giving full range of sizes.

G. A. HARVEY & CO. (LONDON) LTD.
WOOLWICH ROAD, LONDON, S.E.7
ENGLAND
Cables: "Cheaper, London"

H&L Announces

M.J. Crose Manufacturing Company, Inc.
AND AFFILIATES

As distributors of

Teeth that really dig!

Stock carried by:
M. J. CROSE MFG. CO.
2715 Dawson Street
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CROSE PIPELINE COMPANY
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H&L TOOTH COMPANY
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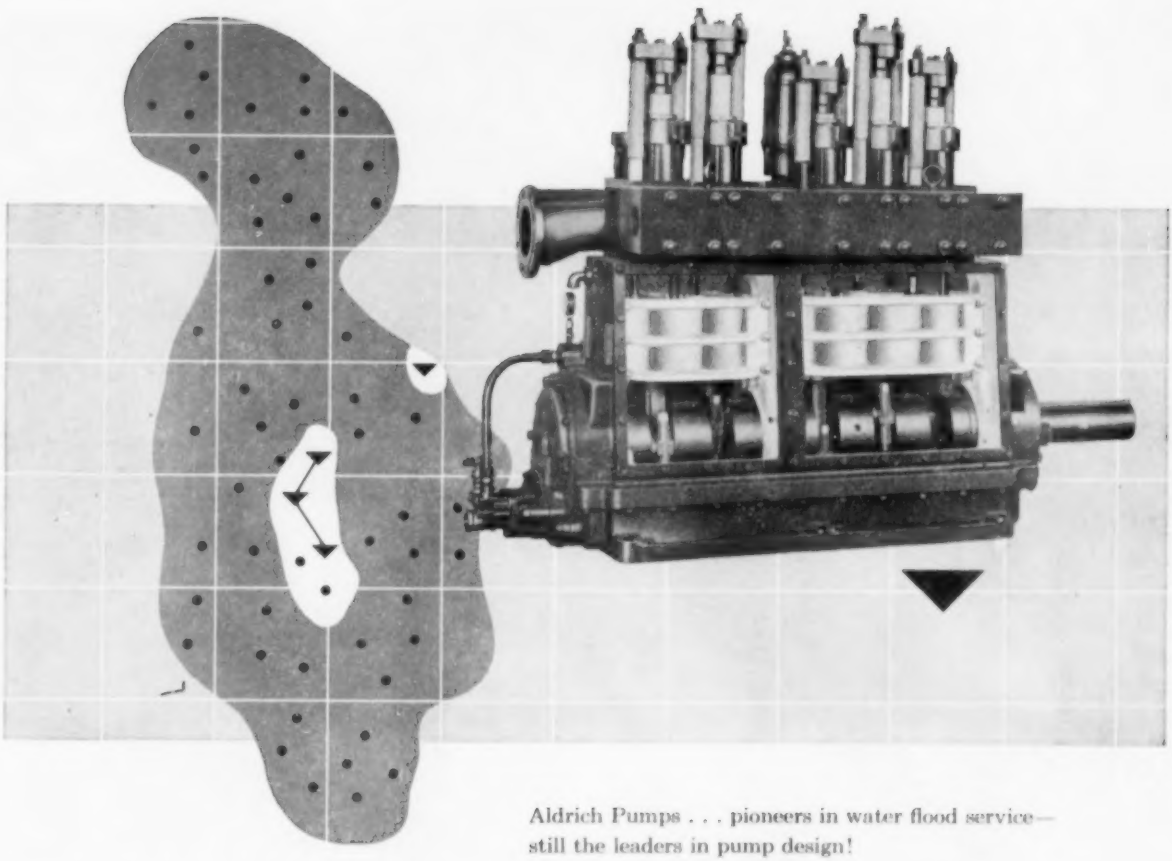


Get peak water flooding efficiency with ALDRICH field-proven Direct Flow pumps

Aldrich Pumps . . . pioneers in water flood service—still the leaders in pump design!

- *high speed*—greater volume from more compact pumps.
- *low maintenance costs*—KOSMOS Porcelain Plungers and completely sectionalized fluid-ends reduce maintenance, material costs and down time.
- *complete range of sizes*—3″ Triplex, 5″ and 6″ Triplex and Multiplex units permit optimum combinations of pumps with maximum interchangeability of parts.
- *for corrosive service*—fluid-ends available in stainless steel or aluminum bronze.

the ALDRICH *pump company*

. . . Originators of the Direct Flow Pump

9 GORDON STREET • ALLENTOWN, PENNSYLVANIA

Representatives: Bushnell Controls & Equipment Co., Inc., 5137 West Jefferson Blvd., Los Angeles 16, Calif. • Cross Pump & Equipment Co., P.O. Box 889, Charleston 23, W. Va. • Lloyd T. Gibbs Co., 1021 Petroleum Bldg., Tulsa 3, Okla. • R. B. Moore Supply Co., Bolivar, N. Y. • Walter Norris Engineering Co., Civic Opera Bldg., 20 North Wacker Drive, Chicago 6, Ill. • Power Specialty Co., P.O. Box 6365, 2000 Kipling Street, Houston 6, Texas; The Suburban Bldg., Room 204, 5526 Dyer Street, Dallas 6, Texas • B. G. Harmon Service & Equipment Co., P.O. Box 309 (Farm Bureau Bldg.), Carmi, Ill. • Stearns-Roger Manufacturing Co., 1720 California Street, Denver 2, Colo. • Export: Petroleum Machinery Corporation, 30 Rockefeller Plaza, New York 20, N. Y.

Direct Flow Spare Parts Stock—at Carmi, Ill., Houston, Los Angeles, Odessa, and Tulsa

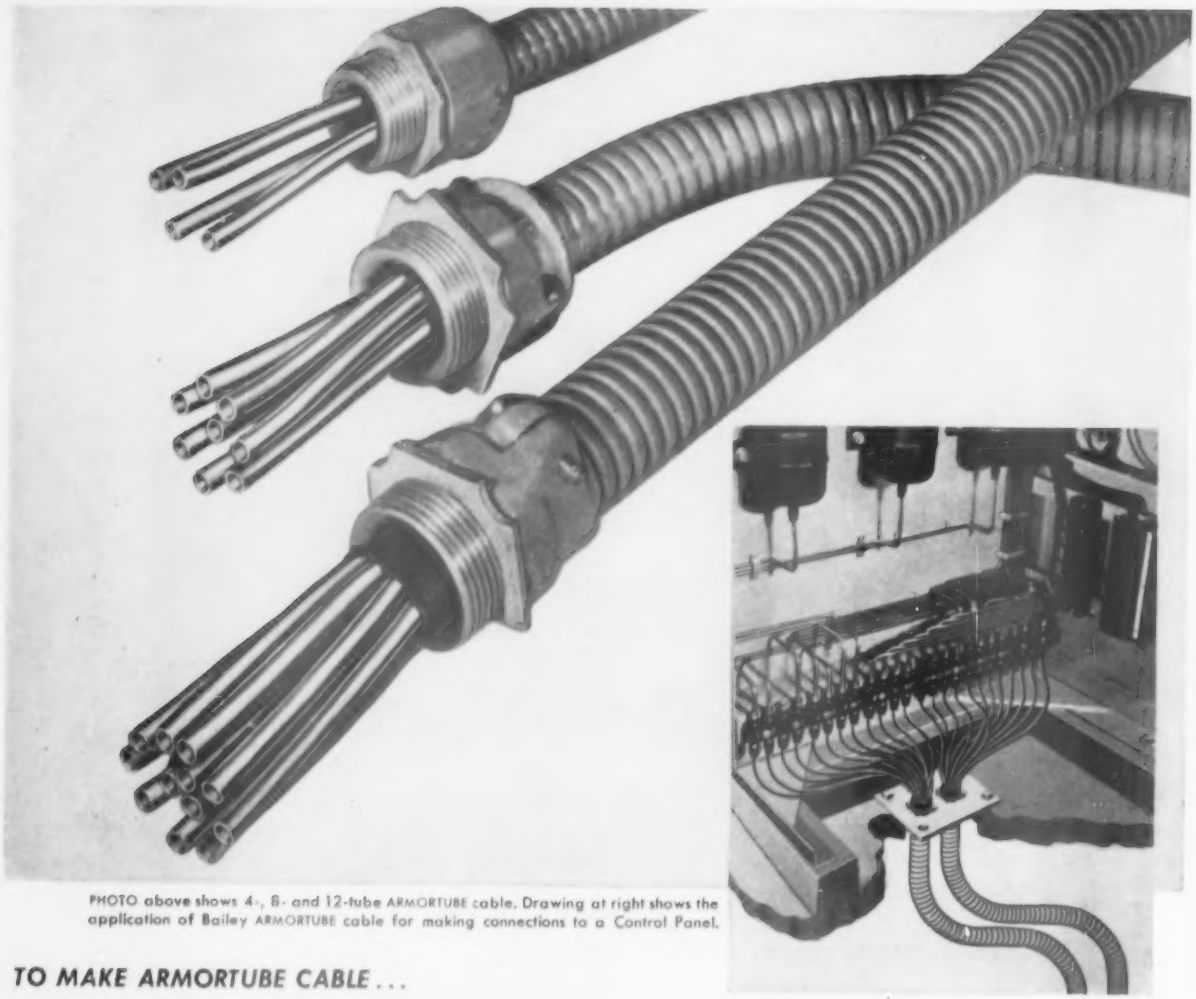


PHOTO above shows 4-, 8- and 12-tube ARMORTUBE cable. Drawing at right shows the application of Bailey ARMORTUBE cable for making connections to a Control Panel.

TO MAKE ARMORTUBE CABLE . . .

Bailey Meter Company turns to Anaconda for long lengths of ¼" O. D. copper tubes

Bailey Meter Co., Cleveland, Ohio, calls its ARMORTUBE Flexible Protected Tube Cable, "the modern shortcut to simpler, safer, more economical air and hydraulic circuits."

As shown above, this cable is available in bundles of four, eight or twelve ¼" O.D. copper tubes. A continuous, heavy galvanized steel strip protects the tube bundle.

Here's why Bailey turned to Anaconda as the logical source of supply for these ¼" O.D. copper tubes.

LONG LENGTHS

Because ARMORTUBE cable is shipped in random lengths of about 500 feet, Bailey needed long lengths of copper tube. Anaconda makes copper tube up to 2,400 feet long, depending on the diameter.

CLEAN INTERIORS

These tubes had to be free from dust, dirt or metal chips which might otherwise interfere with the operation of delicate air and hydraulic circuits. Anaconda takes special care to see that inside surfaces of ANACONDA Copper Tubes are clean, smooth and bright. Tube ends are sealed to keep out moisture and foreign matter during storage.

FLEXIBLE

Tubes had to be flexible enough to bend around corners and obstacles. ANACONDA Copper Tubes are uniformly soft . . . highly flexible. And they are accurate in size and shape.

ANACONDA Dehydrated Copper Tubes are made in all standard sizes up to and including ¾" O.D. Usually furnished in 25-, 50- and 100-foot coils, they are also available in longer lengths on spools and reels where required.

Our Technical Department will be happy to lend a hand on any problem involving the use of copper tubes. A letter outlining your problem will bring a prompt answer. Write to: The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont.

54158

ANACONDA

COPPER TUBES

BEAIRD SPECIFIES **YOUNG**

YOUNG "Mono-Weld" Radiators Cool Largest Packaged Compressor

One of the largest packaged compressors ever built, the new Beaird-Ingersoll-Rand, 10 cylinder, 550 hp 10 SVG, presented multiple cooling problems . . . all solved by Young. Designed for boosting field gas into gathering lines . . . the first problem was to lower the temperature of the gas before it entered the pipelines. Provision had to be made for cooling jacket water and lubrication oil, in a geographic location where extremes of temperatures had to be recognized. Beaird specified Young "Mono-Weld" Jacket Water Cooler equipped with separate coils for water, oil and gas cooling. And, Beaird, specifies Young Coolers as one of the standard components used on all Beaird compressors. Take advantage of Young Heat Transfer experience. Call a Young Representative listed in the "yellow pages" of your telephone book, or write direct.

El Paso Natural Gas Co.'s

Largo Canyon Compressor Station is located forty-five miles from the nearest town in San Juan Basin, New Mexico. Inset shows two 550 hp SVG compressors equipped with Young "Mono-Weld" Radiators. Packaging at Beaird's factory saved weeks of assembly time in the field and enabled them to be put on stream immediately upon arrival. Automatic controls permit operation without a regular attendant.

OIL FIELD REPRESENTATIVES

J. R. MEEK CO., 1341 S. Boston St., Rm. 109, Tulsa, and F. C. WALZ, 301 Irving St., Denver • FLOURNOY & EVERETT, INC., 9346 Stamps Ave., Downey, Calif. • HAROLD J. YOUNG, 206 Montgomery Bldg., Muskegon • JONES & LAUGHLIN STEEL CORP., Supply Div., 106 Main St., Bradford, Penn.; Union Commerce Bldg., Cleveland; 401 Liberty St., Gateway Center, Pittsburgh; Clarksburg, West Virginia.

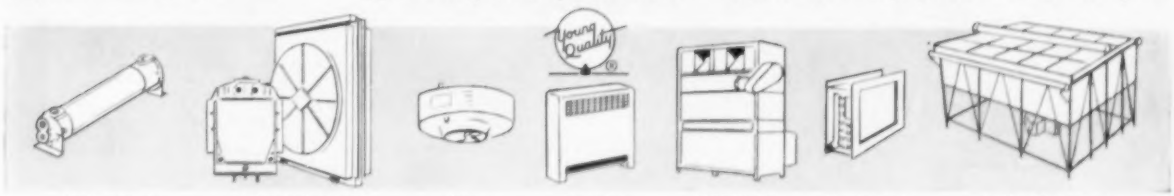
Other Representatives in Principal Cities

Heat Transfer Products for Automotive, Agricultural, Industrial, Gas and Diesel Engine Application.

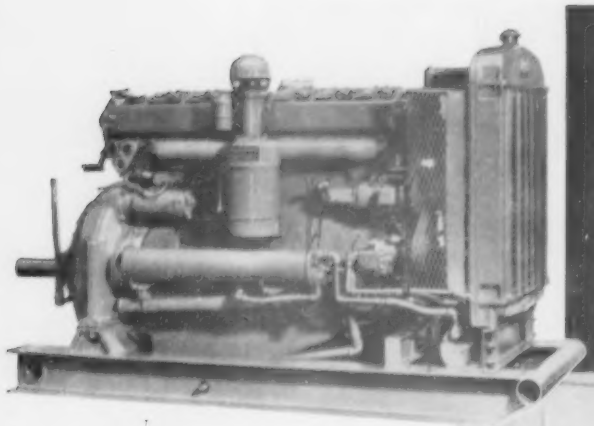
YOUNG

Heating, Cooling, Air Conditioning Products for Home and Industry.

YOUNG RADIATOR COMPANY DEPT. 204-J, RACINE, WISCONSIN • PLANTS AT RACINE, WIS. AND MATTOON, ILL.

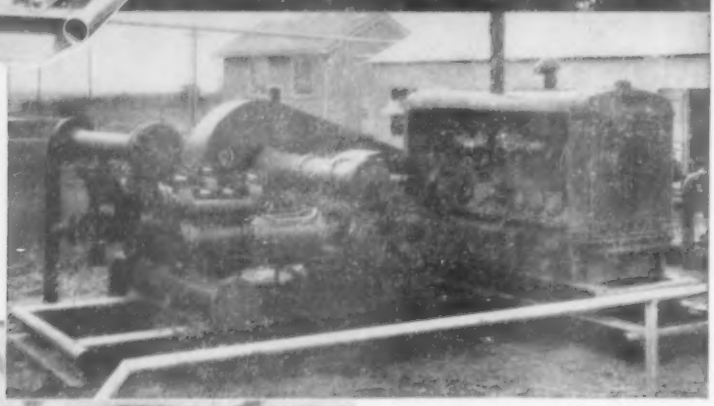


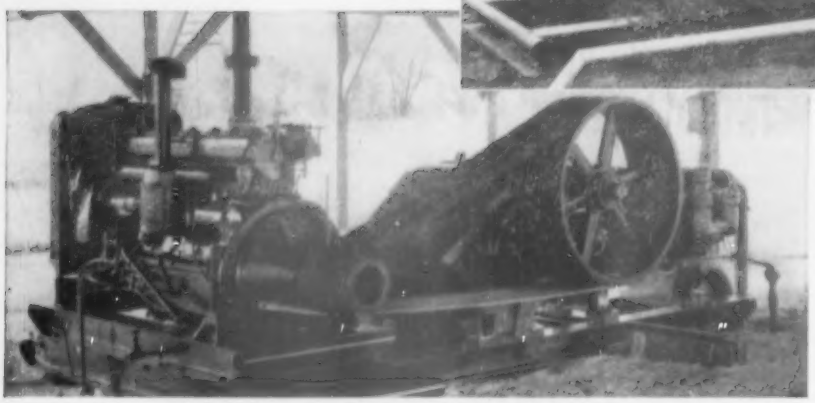
Shell and Tube Heat Exchangers | Automotive and Industrial Radiators | Unit Heaters | Convector Radiators | "YAC" Air Conditioners | Heating and Cooling Coils | "HC" Cooling and Condensing Units



MURPHY DIESELS

rugged, reliable, economical to operate . . .





. . . furnish dependable power for field pumps

Power for pipeline pumping must be rugged, reliable, reasonable in cost. Murphy Diesels provide just such power. Advanced engineering features, including distortionless pistons, interlocking connecting rods, extra heavy crankshafts, dual overhead camshafts and flywheel end cam drive add years to trouble free service. Unit fuel injection and the "true" diesel combustion system assure rock bottom fuel costs.

Put them all together and you can easily see why Murphy Diesels give rugged, reliable, low cost service. Murphy Diesel's high standards of performance and economy are explained in "10 REASONS why your next engine should be a MURPHY". Get a copy from your Murphy dealer or write direct.

MURPHY DIESEL COMPANY 5305 W. Burnham St., Milwaukee 14, Wisconsin

FACTORY BRANCH Sales, Parts and Service—113-116 So. Elwood Ave., Tulsa, Okla.

Murphy Diesel engines and power units, 90 to 260 H.P.; dual-fuel engines, 135 to 215 H.P.; generator sets, 60 to 154 K.W.

275

MURPHY DIESEL

SEE YOUR MURPHY DIESEL DEALER, TODAY—

ALBUQUERQUE, NEW MEXICO, Lively Equipment Company; BUTTE, MONTANA, Hall-Perry Machinery Company; CORPUS CHRISTI, TEXAS, Houston Engine & Pump Company; DALLAS, TEXAS, Conley-Lott-Nichols Machinery Co.; DENVER, COLORADO, Power Equipment Company, EDMONTON, ALBERTA, CANADA, Northern Engine & Equipment Co., Ltd.; GREAT BEND, KANSAS, Manufacturers Dist. Co.; GREAT FALLS, MONTANA, Hall-Perry Machinery Company; HOUSTON, TEXAS, Houston Engine & Pump Co., Inc.; JACKSON, MICHIGAN, Utility & Industrial Supply Co.; LOS ANGELES, CALIFORNIA, Industrial Engine Service; LUBBOCK, TEXAS, Conley-Lott-Nichols Machinery Co.; SAN ANTONIO, TEXAS, The Roy Klossner Company; BAKERSFIELD, CALIFORNIA, Glenn Rose Engine Service; ODESSA, TEXAS, Conley-Lott-Nichols Machinery Co.; LONGVIEW, TEXAS, Nichols Machinery Co.
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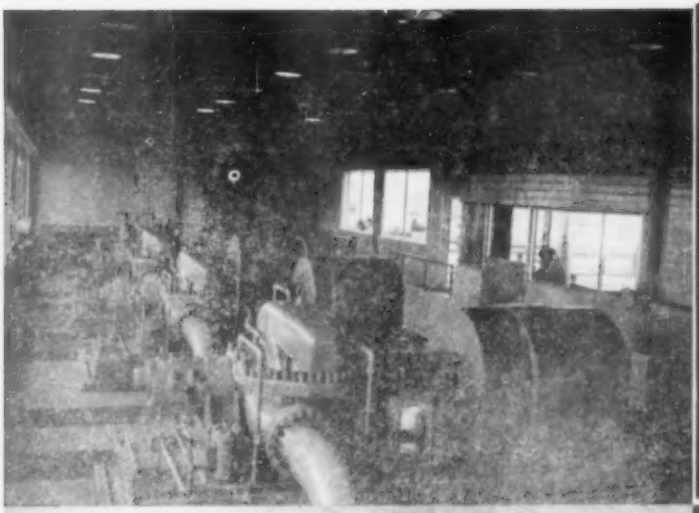

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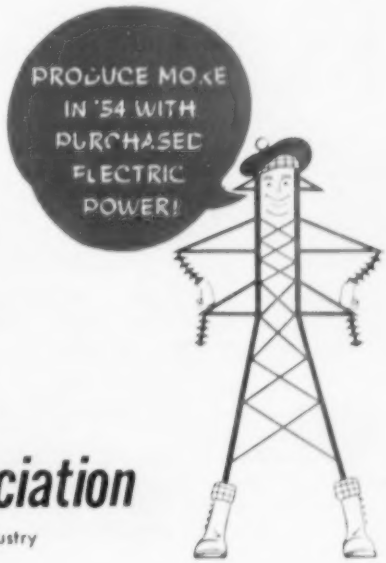

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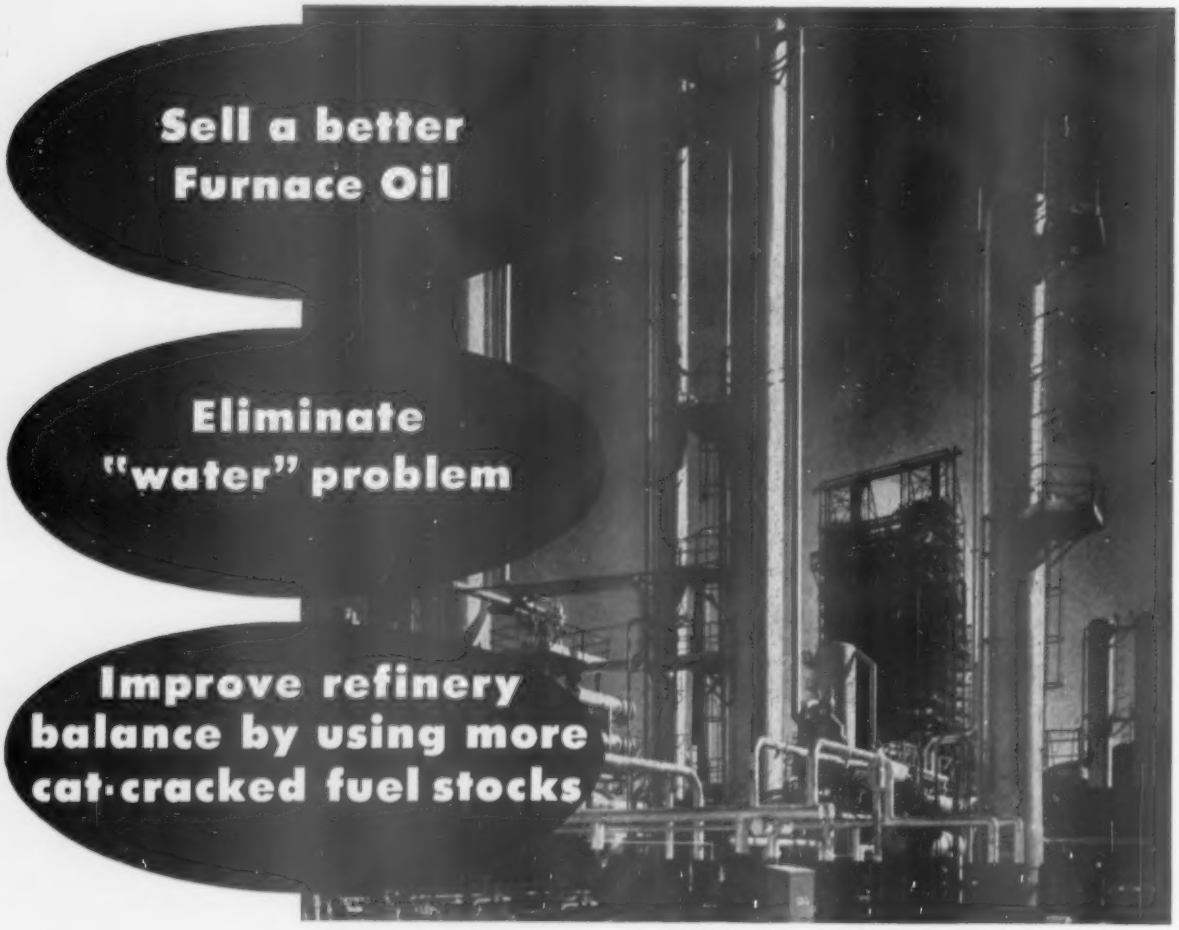

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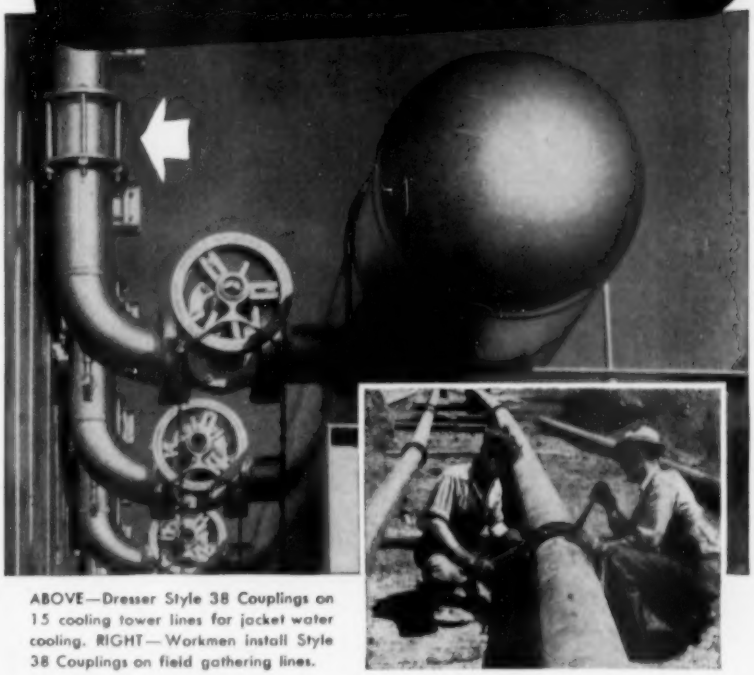

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A special report for pipeline construction men:

Radiographic Inspection of Pipeline Welds

. . . Today's trends in technique, their background, and a helpful digest of defects and acceptability

by W. W. Thayer

THE value of radiographic inspection of pipeline welding is now being increased by two technical developments. One of them is the greater flexibility and economy which have come with the present availability of iridium and which will be even greater with future improvements of cesium. The other significant feature of the technique is the application of standards for interpretation of radiographs which would result in more realistic appraisal of weld quality.

Radiographic inspection of welding is now regarded as more important for controlling faulty tendencies of welders than for eliminating the man who has made poor welds. It costs less to correct faults of a welder than to replace him.

The pipeline industry is getting consistently good service from field welds which are commonly not perfect welds. But they meet service requirements. This point needs to be recognized in radiographic intergretation because the radiograph will disclose defects in almost any field weld which would possibly fail in physical tests, even though the weld as a whole is sound.

After outlining current trends in source material, this article will present a summary of standards for radiographic weld inspection.

Sources of Rays

The present tendency is to favor gamma ray applied from a source outside the pipe. This method has the advantage of more flexibility and ease of handling. The sources of gamma ray which are now attracting particular attention are iridium 192 and cesium 137. Both of these like cobalt 60 are products of the Atomic Energy Commission.

While the X-ray technique has been faster and of better quality than gamma ray, there have been recent developments in iridium techniques which enable iridium to keep up with X-ray in quantity and almost in quality. In fact, iridium is near enough to X-ray in performance to be a practicable competitor. Iridium surpasses cobalt 60 because iridium can do in 10 minutes what it would take cobalt 2 hours to do.

While the trend is now definitely to iridium, it is expected that within 1½ years or so, cesium will be favored in spite of its higher cost.

Iridium has a half life of 74 days. Cesium's half life is 37 years. Cobalt's half life is 5½ years. Radium's half life is 1,600 years, but it is hard to shield because of the short wave length of the rays. This is also true of cobalt.

The radiographic inspection of pipeline welding was first seriously used and tentatively adopted in 1946 and 1947. Although this type inspection had been common in foundries, laboratories, and shipyards for a number of years previous to this date, this was the first major attempt to apply it to pipeline construction.

Since this was in the early years of the present pipeline era, many of the pipeline companies planning bigger and longer pipelines could readily see the advantage of this type of inspection. The weld inspection, aided by a radiographic weld-control service, could easily keep apace with the faster methods being developed for pipeline construction. Advantageous though it was, this service was still considered destructive because of the hole burned or drilled into the pipe adjacent to the weld for the insertion of a radium source. These holes, not more than an inch in diameter, were closed by plug welding or by fillet welding a cap over them; and consequently, steel shavings or burned metal were left in the pipe. This, together with the special crew needed to make and weld these holes, and the stress possibilities in the welded hole area caused many pipeline companies to hesitate to use radiographic inspection.

The hole-in-the-pipe process was soon abandoned and the pipeline welds were radiographed from the outside by gamma ray and from the inside by a newly developed X-ray machine. By eliminating the necessity of this hole, most of the major pipeline companies accepted radiographic weld control as a necessary tool for the weld inspectors.

Three methods of radiographing pipeline welds are in use at present—X-ray from inside the pipe, X-ray from outside the pipe, and gamma ray normally from outside the pipe.

The internal X-ray method, developed in 1947 and 1948, is an especially good method when a high percentage of the welds on a pipeline are to be radiographed. It radiographs a complete circumferential weld in one exposure and produces high-quality negatives.

This internal X-ray machine, privately owned and developed, is unique in that it has its tube and transformer insulated in a lightweight container. The container is cylindrical, approximately 3 ft. in length, 12 in. in diameter, and weighs about 35 lb., with the tube and transformer included. This container is attached to a self-propelled crawler powered by the same source that furnishes power to the X-ray tube. It has a forward, a reverse, and a stop speed; and is controlled by a lightweight instrument panel usually placed near the open end of the pipe. Positive control of the crawler and X-ray can be maintained from this instrument panel. A lightweight cable, little heavier than a common drop cord, carries the electric current to the crawler and X-ray.

This machine, crawler and X-ray, has been known to propel itself through

THE AUTHOR

W. W. Thayer, owner and manager of Thayer X-Ray Service, Tulsa, attended University of Wyoming. Since 1943 he has been engaged in radiographic inspection of welding. At first he did magnetic as well as radiographic inspection in connection with ship building and pressure vessel fabrication. Since 1947 he has conducted radiographic inspection of pipelines. After working as a radiographic specialist for Industrial X-Ray Engineers, Seattle, and X-Ray Engineering Co., San Francisco, he started the radiographic service of Elder & McNulty, Tulsa. Since March 1954 he has operated for himself.

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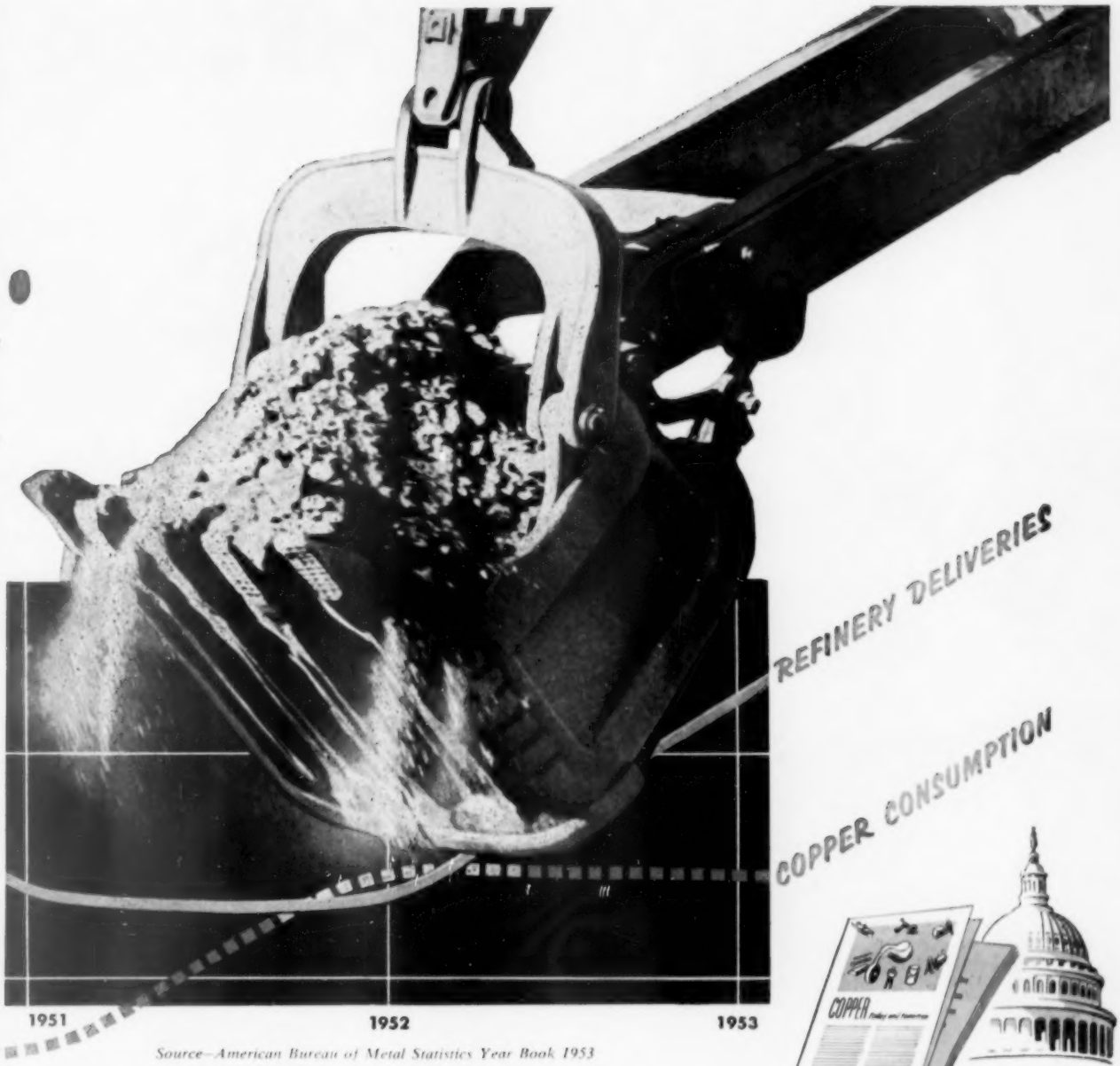

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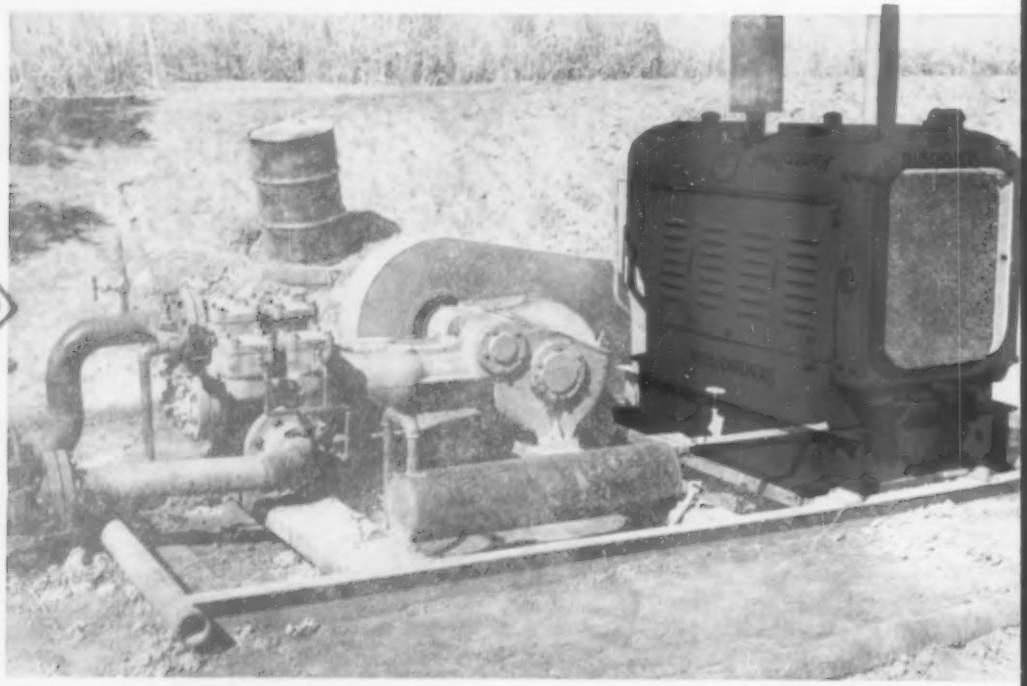

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more than a mile of pipeline. But due to overtaxing the cables and crawler, its recommended travel inside the pipe is about 1,000 ft. However, the machine can be operated several thousand feet from its source of power, and where its voltage is great enough to X-ray from outside the pipe, practically any pipeline weld can be radiographed in this way.

The internal X-ray method does, in some cases, hold up the following cleaning and priming operation and is costlier.

The external X-ray method of obtaining radiographs of pipeline welds is the latest development in this field. These are relatively low-voltage industrial X-ray machines, stripped and streamlined for pipeline work. They do produce high-quality radiographs under normal conditions.

The weight and size of this machine's transformer and control panel make it difficult for it to be moved around conveniently except by truck. Two heavy high-tension cables extend from the transformer to the tube head. These cables are from 30 to 50 ft. in length, making it necessary for the truck bearing the X-ray unit to be within the cable's length distance of the weld to be radiographed. This sometimes presents a problem. On big-diameter pipelines these machines are being operated at peak capacity and the breakdown rate is high if precautionary measures are not practiced.

To radiograph a circumferential pipeline weld, 100 per cent, a minimum of three exposures are necessary. The tube head is clamped to the pipe with the film placed opposite it on the other side of the pipe. After each exposure, the head is revolved around the pipe a short distance for the next exposure. This method is becoming quite popular.

The gamma-ray method, the oldest method of obtaining negatives of pipeline welds, has had many ups and downs since pipeline radiography came into existence. When the hole-drilling method was used, only a small radium source of not more than 500 mg. was needed. When the hole drilling method was discontinued, much more radium was needed for the additional source to film distance of radiographing from outside the pipe.

About this time the Atomic Energy Commission of the United States was producing a radioisotope known as cobalt 60. The first of these sources were used on pipelines for scraper tracing only, the size of the source making it impractical for pipeline radiographic purposes. The industrial demand for an appropriate radioisotope for radiographic work encouraged the development of a highly activated small-sized

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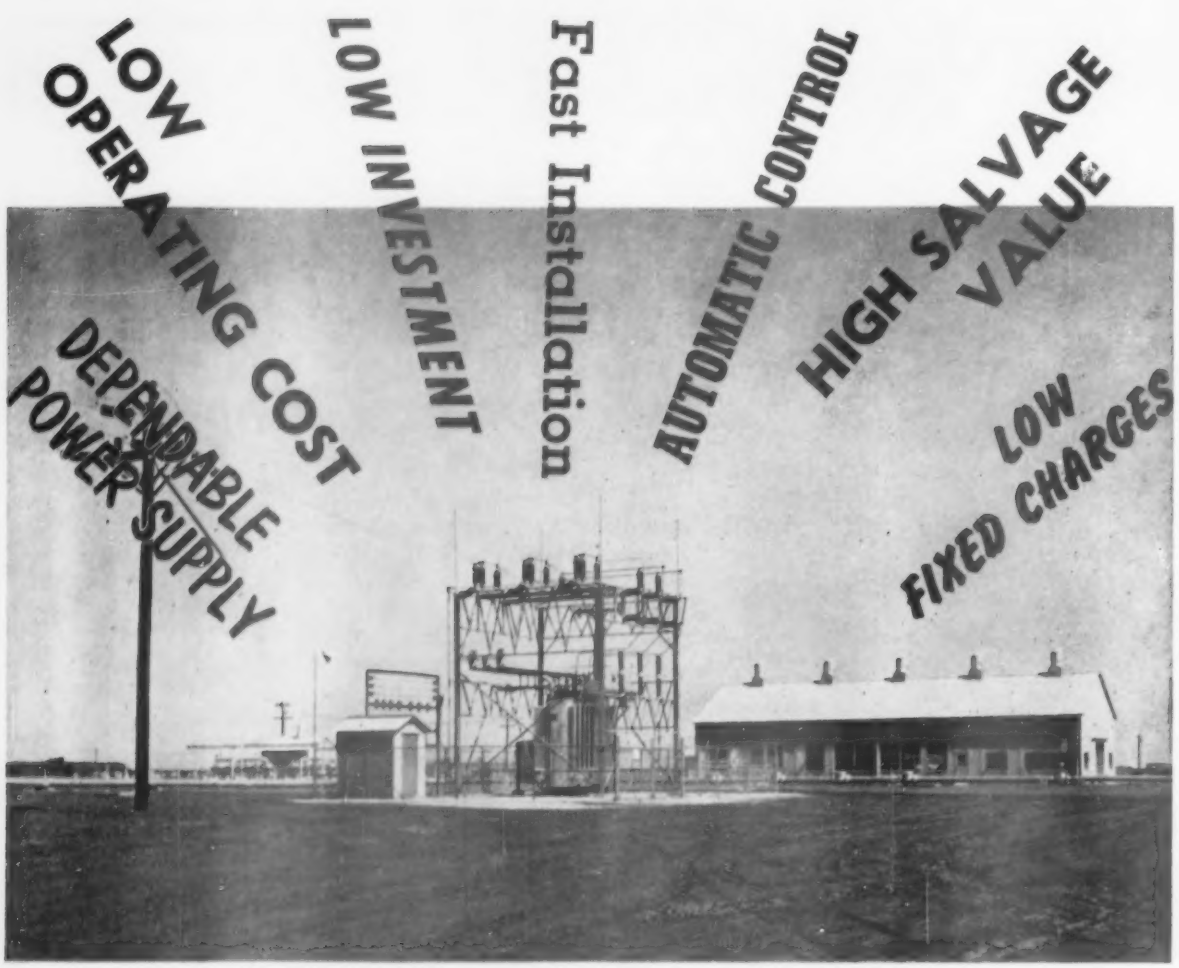

The *Value* of Utility Electric Power for Pipe Line Pumping Greatly Exceeds its Cost.

TEXAS ELECTRIC SERVICE COMPANY

General Office—FORT WORTH

source. At present a cobalt 60 source, adequate for pipeline radiography, is about ⅛ in. long by ⅛ in. in diameter. (Cobalt 60 has a half life of 5½ years.) The gammagraphs or negatives produced by this source on thin-walled pipe are just fair in quality.

About 1951 and 1952, the AEC was producing another radioisotope for industrial use called iridium 192. This isotope produced radiographs of a high quality. The one disadvantage of iridium is its 74-day half life. However, this disadvantage is more than offset by the many advantages it offers.

Although both cobalt 60 and iridium 192 emit gamma rays, the rays emitted by iridium have a much longer wave length and are much easier to shield. The user acquires less radiation from iridium which makes it possible to use a larger source. Also, by radiographing the same subject separately with equal amounts of cobalt and iridium, the exposure time for the iridium will be approximately one-fourth that of the cobalt with the resulting gammagraphs far superior in quality. Recent developments in handling devices enables large sources of iridium to be used safely. For instance, a 30-in. pipe with a ¼ to ⅜-in. wall thickness can be radiographed 100 per cent in less than 10 minutes where formerly it took far more than an hour with the largest permissible cobalt source.

Another radioisotope being produced by the AEC for industrial use and which has a very bright future is cesium 137. It emits gamma rays very similar to those emitted by iridium, and has a half life of 37 years.

The gamma-ray method using any of these sources is very simple. The source is placed outside the pipe and exposes the film placed against the opposite side of the pipe. One man may easily carry all the equipment needed to radiograph several welded joints. The outstanding factors favoring gamma ray are simplicity, portability, and low cost to the pipeline company. Anywhere a welder can make a weld, the radiographer can gamma ray it, and normally over 60 per cent of a weld can be acurately radiographed in one exposure.

There are many radiographic companies in existence at present and many more are being established. Most of these are catering to pipeline construction and offer every possible method of radiographing pipeline welds. The pipeline companies can obtain the method they desire and can be reasonably assured of a high-quality service.

Radiographic inspection of pipeline welds by any of the methods discussed is not in itself a complete inspection. The negatives produced by these meth-

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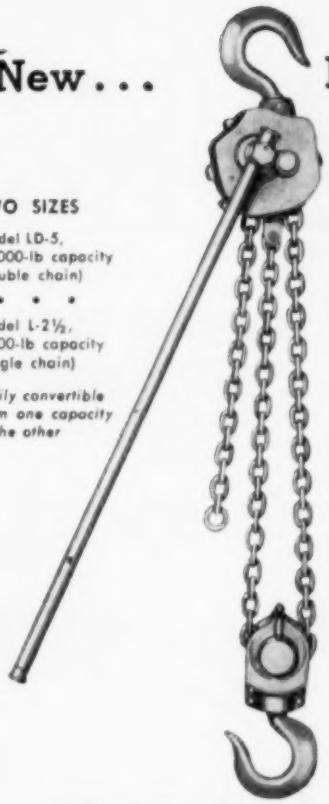

For over two years the entire production of Coffing's new Super Power Ratchet Lever Hoist has gone into military service. Now it is available to bring new standards of ratchet hoist performance to civilian users. These are just a few of the advantages this new hoist offers:

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The 5-ton model weighs but 58 lb — lightest weight ratchet hoist in this capacity on the market.

Only 70 lb of handle pull needed to lift 10,000 lb with patented compound lever principle.

You get coil chain flexibility plus free chaining for quick adjustment.

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Ratchets and pawls are specially hardened alloy steel — *every* load-holding ratchet is tested at 30,000 lb.

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Bingham Pipeline Pumps are of "Double Volute" design, insuring perfect radial balance of the rotating element. This "Hydraulic Radial Balance" eliminates the unequal pressures on the shaft that are the primary cause of wear and maintenance in conventional pumps.

"Double Volute" design also makes possible a more compact multi-stage design, resulting in reduced load on case boltings. Dual-stage cross-overs, *possible only* with "Double Volute" construction, reduce the axial space between stages, effectively decreasing the overall length of the pump shaft and the span between main bearings. All this adds up to *low maintenance* and trouble-free service.

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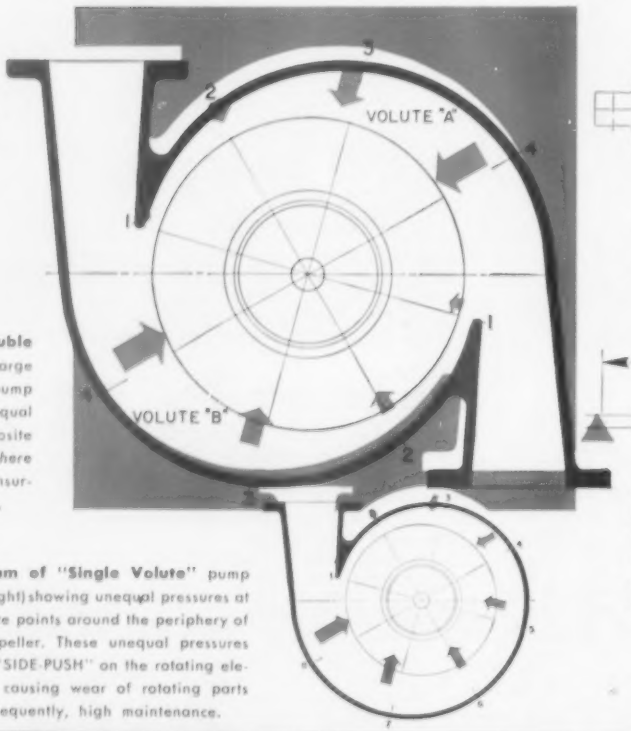
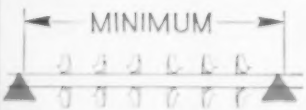


Diagram of a "Double Volute" double discharge case of a multi-stage pump (right) showing the equal pressure on the opposite sides of impeller. *There is no* "SIDE-PUSH", insuring low maintenance.

Greater Compactness in multi-stage "Double Volute" design reduces load on case bolting.



A Wide Range of Operating Speeds Is Possible because "Double Volute" construction reduces the overall length of pump shaft and the span between the main bearings.

Diagram of "Single Volute" pump case (right) showing unequal pressures at opposite points around the periphery of the impeller. These unequal pressures cause "SIDE-PUSH" on the rotating elements, causing wear of rotating parts and, frequently, high maintenance.

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1. **Dubuque—Moorhead Pipeline**
2. **Mandan—Moorhead Pipeline**
3. **Whiting—River Rogue Pipeline**

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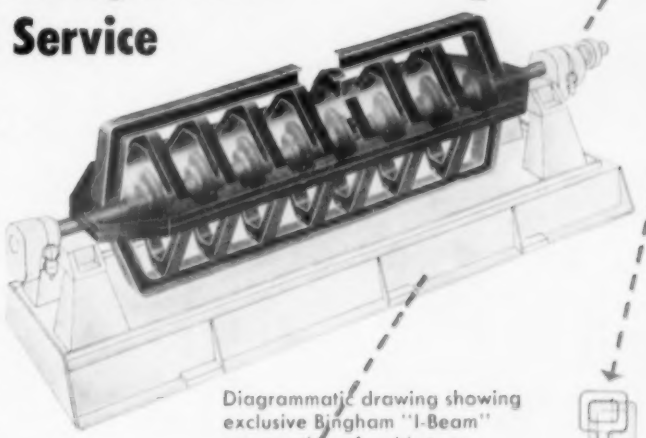
2

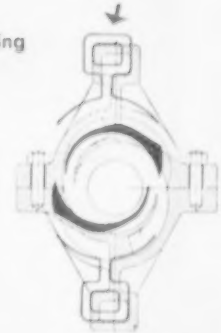
Assured Case Strength for High-Pressure Service

Integral cross-overs in Bingham "Double Volute" multi-stage pumps produce casings of maximum strength for high pressure service because each cross-over is cast integrally with its half of the pump casing, and thereby becomes a structural member of Bingham's "I-Beam Truss Construction".

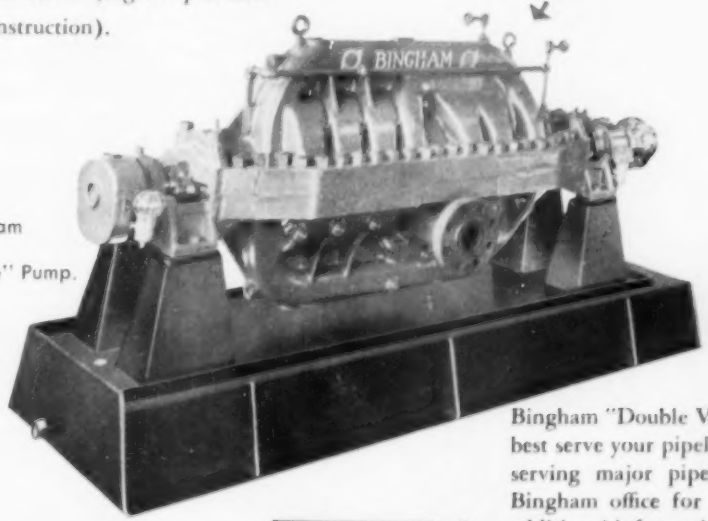
This feature, found only in Bingham pumps, increases the strength of the pump casing to such an extent that it can safely withstand pressures up to 2000 psi with standard construction (higher pressures with special construction).



Diagrammatic drawing showing exclusive Bingham "I-Beam" construction of multi-stage "Double Volute" pump.



A transverse cross-section of Bingham "Double Volute" Multi-Stage Pumps, showing identical cross-overs cast integrally with the upper and lower halves of the pump casing.



Typical Bingham Multi-Stage "Double Volute" Pump.

Bingham "Double Volute" Multi-Stage Pumps will best serve your pipeline operations, as they are now serving major pipelines. Write to your nearest Bingham office for "Double Volute" Bulletin or additional information.

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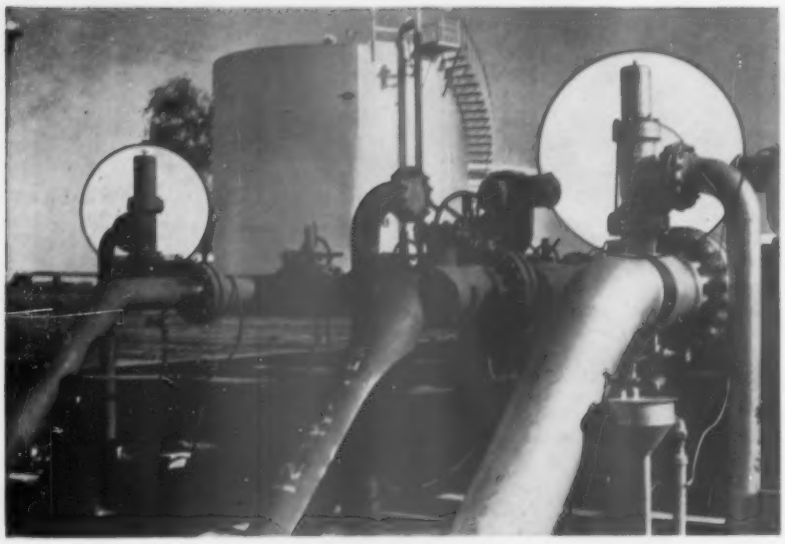

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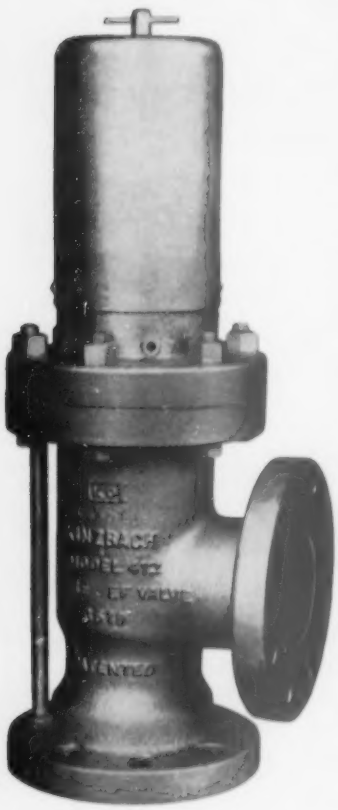

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ods are actually obtained by the X-rays or gamma rays passing through a metal and exposing a film placed against the opposite side of the metal. When voids or foreign matter less dense than the metal being radiographed are present, a greater number of rays will pass through and expose the film more at that point. Therefore void defects will appear as dark spots or dark areas in the weld image of the radiograph, and the radiograph will expose only such voids. The radiograph will not expose any structural or chemical changes in the metal, and in most cases will not expose laminated conditions. It is necessary to have a vigilant weld inspector on the job when welding is being done.

The radiographer, operating from his mobile dark room unit, is able to follow closely behind the welders. The unit has film processing facilities, and the films are developed soon after being exposed. This gives the inspector immediate weld information so that any inferior welding technique can be corrected before excessive damage is done. Also, the psychological effect of the unit's presence in the vicinity of the welders is as valuable in obtaining high-quality welds as is the actual radiographic inspection.

Radiographs should be taken of each welder's work each day. Welders whose work is not up to standard should have their welds radiographed oftener until they correct their technique or have been replaced.

Field reports should be made out each day in quadruplicate. The pipeline company's main office and the welding inspector should each receive a copy of this report daily. A third copy should accompany the negatives which are given to the welding inspector in dated and labeled boxes or envelopes after they are completely processed. The fourth copy should be retained by the radiographic company.

This daily log should be clear and precise giving the date, radiograph number, welder, and location of the weld, together with a complete and accurate interpretation. This will give another opinion of the quality of the weld.

Locating defects in the weldment from the radiograph is relatively easy. Lead identifying numbers should be placed adjacent to the weld so that their image will appear on the negative. All negatives of one exposure should have the same identifying radiograph number. There may be one or many negatives of each exposure depending on the size pipe being radiographed. The individual sections of the negatives can be identified as to their position on the weld by a number belt. This belt is placed completely around the pipe adjacent to the weld and op-

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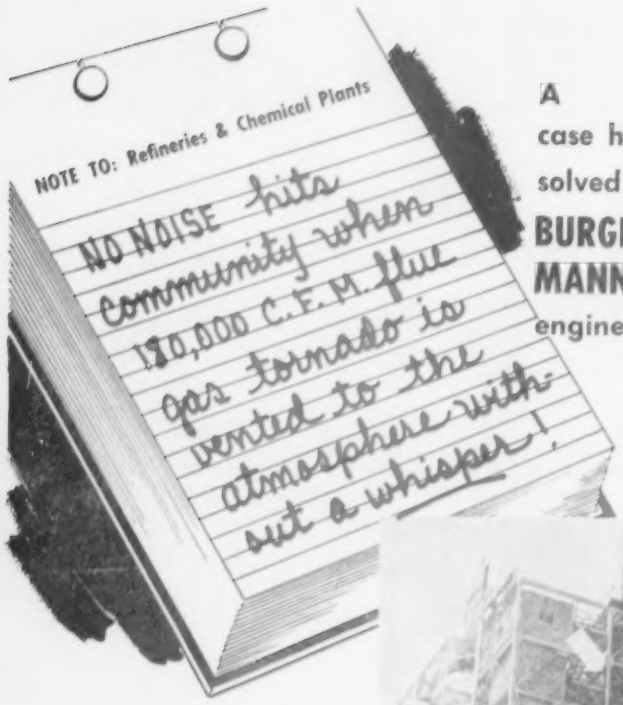
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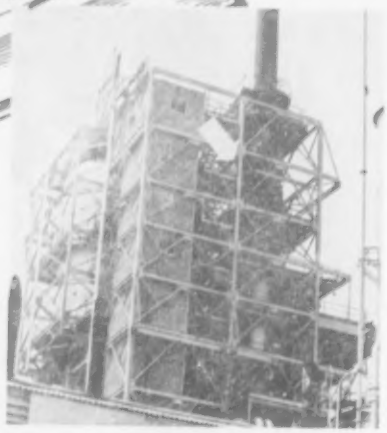

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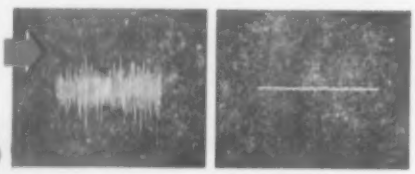

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posite the exposure numbers. The lead numbers attached to the belt should be spaced 5 or 10 in. apart and read clockwise in order looking in the same direction as the pipeline construction is progressing. The zero position of the number belt is at the top center of the pipe. The images of these lead numbers appear on the negatives. By noting the position of the defect in relation to the image of the belt numbers, the defect can readily be located as to its position in the weld.

To obtain the best results from this service, the radiographic unit and its operator should be considered as just another tool of the weld inspector to use in his effort to maintain high-quality welding. The radiographer should cooperate with the weld inspector, or the pipeline company's representatives in every way possible. He should aid them in acquiring the knowledge of interpreting radiographs, and he should keep the welfare of the pipeline his main objective.

For convenience, interpretation and standards of inspection are included together in the discussion of each class of welding defect presented in the following summary of radiographic weld standards.

Radiographic weld control has been adopted as a fast and economical method of nondestructive testing for the inspection of pipeline and compressor-station welding. The product of this inspection service is a graph or negative of the weld for a permanent record, and an interpretative report of the negative for immediate weld information.

The use of radioisotopes emitting gamma rays is one method adopted to obtain negatives or gammagraphs of the welding. These gammagraphs are actually produced by the gamma rays passing through a metal and exposing a film placed against the opposite side of the metal. When voids or foreign matter less dense than the parent metal being radiographed are present, a greater number of rays will pass through and expose the film more at that point. Therefore, void defects will appear as dark spots or areas in the weld image of the radiograph.

Accurate interpretation of the gammagraph is essential to the value derived from radiographic weld control. This can be accomplished by correctly identifying the defect and determining its seriousness. The size, location, and shape of the defect or dark spot on the weld image of the gammagraph are the important factors to be considered when identifying the defect.

The shape and density, together with the quantity and extent of the defects, must be considered when determining the seriousness of the defects. The quan-

tity, length, and width of the defects are easily dealt with by the use of weld standards or specifications. But the depth and seriousness of the defects present more of a problem. A defect may be within the limitations set forth by the weld standards and still be a serious threat to the weld's strength because of its depth and shape.

One method of determining the depth of a defect is by utilizing the density difference between the weld image and the parent metal. If the density of the void defect is similar to that of the parent metal, then the defect is as deep as the weld reinforcement is thick. If the density of the defect is twice that of the parent metal then the defect will be twice the thickness of the weld reinforcement. If three times as dense, then the defect will be three times as deep as the weld reinforcement is thick.

The shape of some defects is important. These defects when occurring with sharp and pointed irregularities are far more detrimental to the strength of the weld joint than those with more regular shapes. Whenever a vibrating or pulsating condition exists, the defects occurring in the surface of the weldment or adjacent parent metal, either inside or outside the pipe, are poteatial cracks. This is also true of any abrupt change in the plane surface of the pipe at the welded joint, such as an extreme high-low condition. Sharp elongated burn-throughs, lack of penetration, undercuts, and nonfusion areas are the defects most likely to start cracking under the above-mentioned conditions. Cracks have also occurred with arc burns as their starting point. The defects named in this paragraph are described and defined in the following paragraphs. Also following is a set of descriptive and detailed weld standards for pipeline and compressor-station welding for those interested in acquiring knowledge of gammagraph interpretation.

Abbreviations Other Than Weld Defects

I.S—Long seam (longitudinal weld).

SB—Stringer-bead pass (first weld deposit pass).

HP—Hot pass (second weld deposit pass).

FP's—Filler passes (weld deposits between hot pass and cover pass).

CP—Cover pass (weld reinforcements).

Pipeline Radiographic Weld Standards

BURN THROUGH (BT).—A burn through is a crater in the root of the weldment after that portion of the weld and adjacent parent metal has been broken down and dissipated.

Characteristics, visual . . . An irregular slag-rimmed crater in the weld root and

ANDERSON Hi-eF PURIFIERS

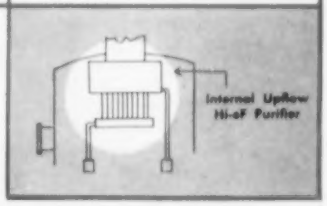
CASE STUDY

PROTECTING COMPRESSORS IN NEW YORK MANUFACTURER'S PROCESSING PLANT

No. 104

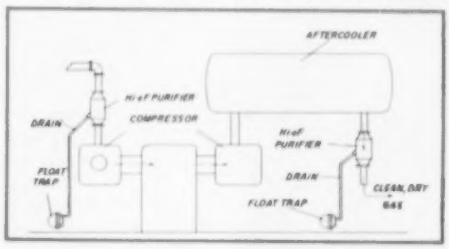
EQUIPMENT REQUIRED:

One Hi-eF Upflow Internal Purifier (Type IMS-16)



SERVICE:

Handling 17,190 #/hr.hydrocarbon gas at 15 PSIA and 90° F. Installed in tower through 18" manway to remove up to 10% entrained liquid from the gas to charge compressor suction.



EQUIPMENT REQUIRED:

One Hi-eF Line Purifier (Type L8-300).

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Handling 32,585 #/hr. ethylene gas at 180 PSIG and 12° F. Installed in compressor suction line to remove up to 10% entrained liquid from gas to compressor.

RESULTS:

The Hi-eF Purifiers by removing 99% of the entrained liquid in the gases, are giving continuous and complete protection to the compressors. This protection is vital because it assures continuous operation of the plant since the compressors are one of the most important units in the process. No shutdowns reported since the purifiers have been placed in operation.

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Electric Fusion Weld Line Pipe—shown here is for high pressure gas line from Petersburg, Ohio, to Cleveland, Ohio. Uniform circumference and wall thickness of this 26″ pipe assure high speed welding operation. Republic's rigid standards of quality control guard against pipe that is not uniformly straight.

Continuous Butt Weld Line Pipe—here used on central flowing manifold near Kilgore, Texas. Republic's proved continuous weld process assures uniform wall thickness, diameter and concentricity . . . is easy to bend and thread. It comes in economical long lengths and extra-long lengths.

Electric Resistance Weld Line Pipe—in 10¾″ size, will carry crude oil between Oklahoma and Texas. High ductility of steel permits easy field bending to match terrain. And each length is consistently uniform. Result: faster laying time, lower installation costs.

Uniformity is one outstanding feature all Republic Line Pipe has in common. It's perhaps the most important reason thousands upon thousands of satisfied customers use more and more Republic Line Pipe each year. To them, *uniformity* means all-around protection for their investment. It means fast, economical installations, dependable service.

Take Republic's Expanded Electric Fusion Weld Line Pipe, for example. This big pipe—sizes 24″ to 30″ O.D.—is electric fusion welded inside and out, then hydraulically expanded to uniform size, straightness, and circumference to increase its high yield strength. It goes in fast. Because circumference is constant, field joints line up quickly and accurately, can be welded at top speed. And, to further speed welding, uniform wall thickness provides an even distribution of metal all around the pipe.

Republic Electric Resistance Weld Line Pipe—sizes 2⅜″ to 16″ O.D.—is formed from flat rolled steel, uniformly thick from side to side and end to end. This results in uniformly concentric pipe, uniform in wall thickness—easy to line up, easy to weld. Its high ductility assures smooth, uniform bends in the field or in the shop. Uniform, high-yield strength permits building high pressure lines. And clean surfaces inside and out prevent clogged valves and regulators, often caused by scale loosened after blowing out the line.

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adjacent parent metal, the walls of which are covered with burned metal and slag. This crater may extend into the hot pass and even into the filler passes.

Radiograph . . . A dark area in the weld image of the film. It may vary in size and density but is definitely noticeable. The defect can be normally identified by the lighter, broader ring surrounding its outer extremities. This broad light ring is the result of the burned metal and slag from the BT adhering to the crater rim.

BT's occur more frequently in pipeline welds than any other single defect. This is especially true when the pipe ends are hand or field beveled. Since BT's will occur in pipeline welds due to prevailing field conditions, all welds containing BT's should not be rejected. A weld containing BT's should be given much consideration before a decision is reached when interpreting the radiograph. The foremost factor to be considered is the length and width of the BT. The second factor to be considered is the depth and the number of defects present in the weld. The quantity, length, and width of BT's are easily dealt with by the use of weld standards or specifications. But the depth and seriousness of the defect presents more of a problem. A BT may easily be within the limits set forth by the weld standards yet be serious because of its depth or shape.

The shape of a BT is important. A BT with sharp and pointed irregularities is far more detrimental to the strength of the welded joint than those with more rounded and regular shapes. The pointed BT is a potential crack, especially in a welded joint where high carbon steel pipe is used and a vibrating or pulsating condition exists.

The depth of a BT can be reasonably determined by the comparison of densities mentioned previously. A BT crater that has been filled by following passes should still be considered as a BT if it is outlined with a dark line. This dark line is the slag-filled crevice between the crater walls and the protruding weld metal of the following passes. The weld metal of the following passes does not fuse completely to the slag-covered walls of the crater.

Acceptability . . . Any BT crater shall not exceed ¾ in. in length nor ¼ in. in width. There shall not be more than 2 in. of BT in any 12-in. length of

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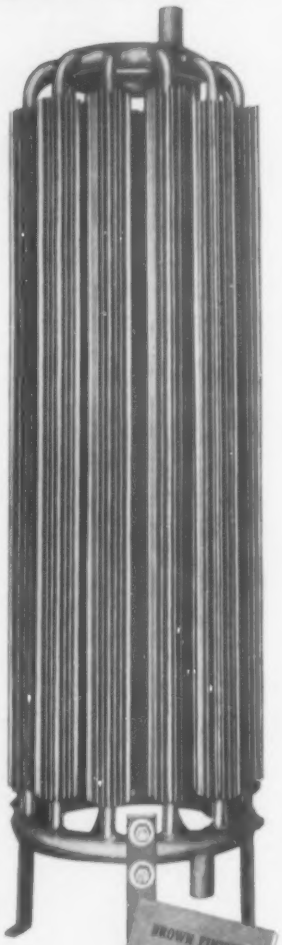

• Users report that our vertically mounted TF-18 Tank Heaters cost less **including the installation** than just installing old fashioned bare pipe coils in the bottom of a tank. Also, the vertical mounting prevents sediment from settling on the heating surfaces as when the old fashioned coil is used. This means more efficient, less costly heating. It avoids heating through a layer of sediment and leaves the tank floor uncluttered and easy to clean.

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weld, and individual BT's shall be separated by at least 4 in. of sound metal. No weld shall contain more than 5 per cent BT's in the linear length of the weld. Any weld containing a BT the gammagraph of which indicates a depth greater than one-fourth the thickness of the parent metal will not be accepted regardless of its dimensions.

STRINGER-BEAD WINDOW (SBW). A void in the root of the weld. A portion of the molten metal of the stringer bead moved ahead before solidifying, leaving a gap in the weld deposit.

Characteristics, visual . . . A triangle-shaped void in the stringer bead. A SBW crater is similar to that of a BT but without the slag-covered walls or slag encircling its edges.

Radiograph . . . A dark spot in the weld image of the radiograph somewhat triangular in shape. In extreme cases a SBW may have a shape similar to that of an arrowhead with the broad end slightly concave. SBW's are seldom wider than the stringer-bead image.

Acceptability . . . Same as burn through.

SLAG LINE (SL). — Elongated slag-filled voids occurring between any two weld deposit passes and the base metal. SL is most frequently slag trapped by the hot pass in the stringer bead undercut. The weld deposit of the hot pass bridges over the undercut.

Characteristics, visual . . . Elongated slag-filled voids varying in length, but normally occurring between the weldment and the parent metal.

Radiograph . . . A dark, slightly irregular line adjacent to and paralleling the stringer bead image of the radiograph. It may appear on either side of the stringer-bead image.

Acceptability . . . Any slag line shall not exceed 3 in. in length, and not have more than 3 in. of SL in any 12 in. of weld. No weld shall contain more than 7 per cent of SL in the linear length of the weld. Extreme width of SL shall not be accepted. Any weld containing slag line, the gammagraph of which indicates a depth over one-fourth the thickness of the parent metal, will not be accepted regardless of its length.

WAGON TRACKS (WT). — Slag trapped in the stringer-bead undercut. The hot pass bridges over the undercut thus leaving elongated slag-filled voids.

Characteristics, visual . . . Elongated slag-filled voids similar to SI, except occurring in both stringer-bead undercuts simultaneously.

WAGON TRACKS

Radiograph . . . Dark, slightly irregular lines adjacent to and paralleling both sides of the stringer bead image of the radiograph.

Acceptability . . . Any WT shall not exceed 2 in. in length, nor shall there be more than 2 in. of WT in any 12 in. of weld. No weld shall contain more than 4 per cent WT in the linear length of the weld. Individual WT's shall be separated by at least 4 in. of sound metal.

SLAG INCLUSIONS (SI).—Slag-filled void in weld deposit.

Characteristics, radiograph . . . Dark, irregular-shaped spots in the weld image of the radiograph. This defect is not common in pipeline welding.

Acceptability . . . Any individual SI shall not exceed ¼ in. in size. No weld shall contain more than two SI's whose individual dimensions are greater than ¼ in.

LACK OF PENETRATION (LP).—Insufficient weld metal at the root of the weldment.

LACK OF PENETRATION

Characteristics, visual . . . Weld metal does not penetrate to inside edges of pipe ends. Inside surface of pipe ends still exposed and are not fused with the weldment.

Radiograph . . . A dark, straight line located at the center of the weld image of the radiograph where the stringer-bead image should be. This defect can be readily detected by the lack of a stringer-bead image in that area, by its location at the center of the weld image, and by its perfect straightness.

LP should be considered as a potential crack where any movement of the welded pipe may be encountered. This is especially true where the weld is subject to vibration.

Normally occurring with LP is a cold lap or nonfusion condition. The weld metal does not fuse completely to the parent metal at the deepest point to which the weld metal penetrates.

Acceptability (Pipeline) . . . Any LP shall not exceed 1½ in. in length. No

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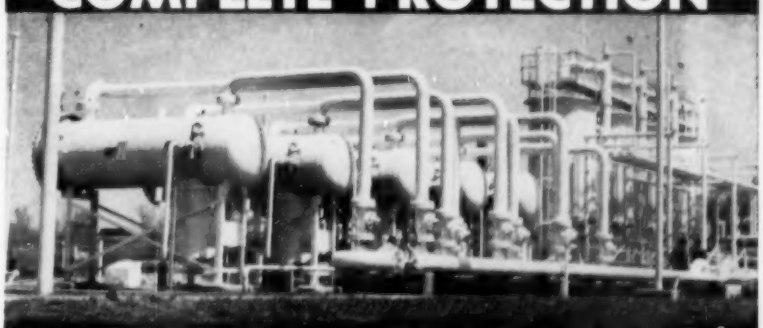

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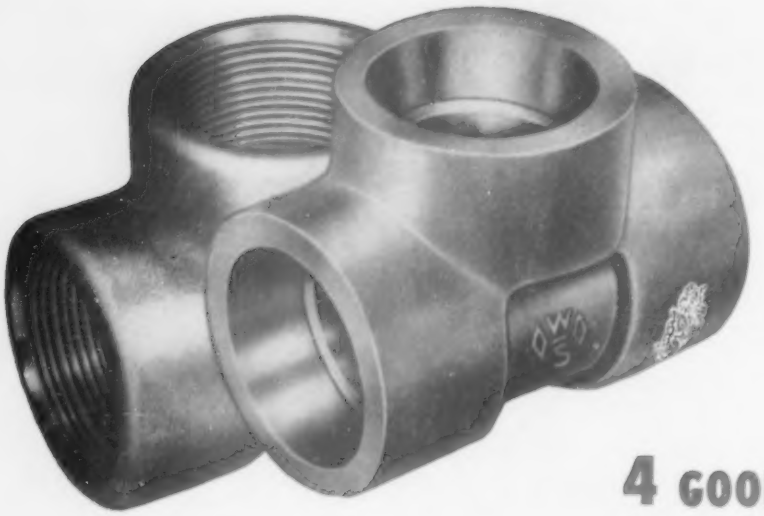

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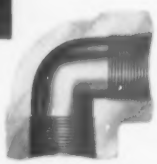

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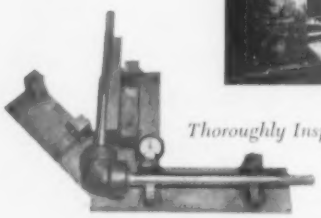

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weld shall contain more than two LP's whose individual lengths are 1½ in. Individual LP's shall be separated by at least 8 in. of sound metal. No weld shall contain more than 4 per cent of LP in the linear length of the weld. Any weld containing LP the gammagraph of which indicates a depth of over one-fourth the thickness of the parent metal will not be accepted regardless of its length. **(Compressor stations)** . . . Any LP shall not exceed ¾ in. in length. No weld shall contain more than two LP's whose individual lengths exceed ¾ in. in length. Individual LP's shall be separated by at least 12 in. of sound metal. No weld shall contain more than 2 per cent LP in the linear length of the weld. Any weld containing LP the gammagraph of which indicates a depth of over one-eighth the thickness of the parent metal will not be accepted.

HIGH LOW (HL).—Misalignment of pipe ends.

HIGH LOW

Characteristics, visual . . . Offset of one pipe end from the other at the welded joint of the two.

Radiograph . . . An indefinite line in the center of the weld image. It may vary in length according to the extent of the defect. The weld image on one side of this imaginary line will be dark while the other side will be lighter. There will be an indefinite or imaginary line, not a definite straight, dark line.

Acceptability . . . HL shall not exceed ⅛ in. at any point and there shall not be more than 10 per cent extreme HL in the linear length of the weld. See LP due to high low.

LACK OF PENETRATION DUE TO HIGH LOW (LP-HL).—Misalignment of pipe ends with an LP condition present.

Characteristics, visual . . . Offset of one pipe end from the other at the welded joint. The inside surface edge of one pipe end is not completely fused to the weld metal.

Radiograph . . . A dark, straight line in the center of the weld image of the radiograph. This line may vary in length according to the extent of the defect. The weld image on one side of the line will be dark and the other side will be lighter. A portion of the stringer bead image will often appear adjacent to the dark line and on the

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darker side of the weld image. There will be a definite straight, dark line.

Acceptability . . . Same as LP.

NONFUSION (NF). — Partial nonfusion of weldment to parent metal.

Characteristics, visual . . . A crevice between the weldment and one or both pipe ends usually occurring at the root of the weld. Weld metal sags against the parent metal with only partial fusion.

Radiograph . . . Faint shaded area located on either or both sides of the stringer-bead image of the radiograph. The shaded area will vary in length and will resemble SL except to be wider and with less definition.

Acceptability (Pipeline) . . . Any NF shall not exceed 1½ in. in length. No weld shall contain more than two NF's whose individual lengths are 1½ in. Individual NF's shall be separated by at least 8 in. of sound metal. No weld shall contain more than 4 per cent NF.
(Compressor station) . . . Any NF shall not exceed ¾ in. in length. No weld shall contain more than two NF's whose individual lengths are ¾ in. Individual defects shall be separated by at least 12 in. of sound metal. No weld shall contain more than 4 per cent NF.

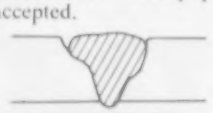
CONCAVE STRINGER (CS).—Insufficient weld metal in the stringer-bead pass.

CONCAVE STRINGER

Characteristics, visual . . . The stringer bead inside the pipe is fused to the inside edge of the pipe ends but is shrunken and low at the center.

Radiograph . . . A dark area similar in size and shape to the lighter stringer-bead image. CS may occur at any point on the circumference of the pipe.

Acceptability . . . Any CS shall not exceed 3 in. in length, nor shall there be more than 3 in. of CS in any 12 in. of weld. Individual CS's shall be separated by at least 6 in. of sound metal. No weld shall contain more than 6 per cent CS. Any weld containing CS the gammagraph of which indicates a depth of more than one-fourth the thickness of the parent metal at any point will not be accepted.



EXTERNAL UNDERCUT

UNDERCUT (UC).—Grooves melted into the parent metal adjacent to the

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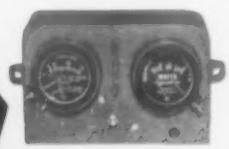

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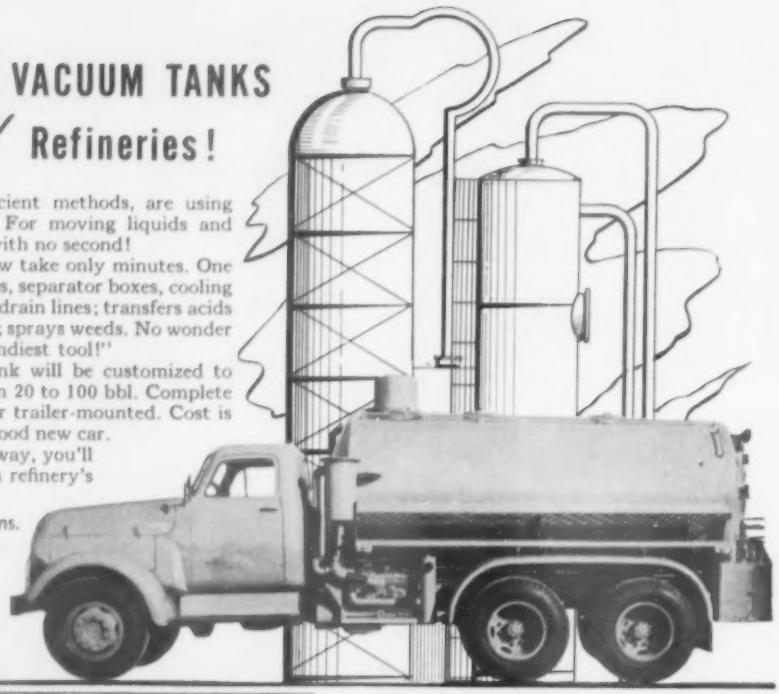

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cover pass and left unfilled by the weld deposit.

Characteristics, visual . . . Irregular grooves in the parent metal at the edge of the cover pass.

Radiograph . . . A dark, irregular line or connected spots located on either or both sides of the weld image.

Acceptability (Pipeline) . . . Any weld containing excessive UC should be repaired. **(Compressor station) . . .** Any UC should be ground out, inspected, and then rewelded if no cracks appear.

INTERNAL UNDERCUT (IUC).—Irregular grooves in the parent metal inside the pipe adjacent to and paralleling the protruding weld metal.

INTERNAL UNDERCUT

Characteristics, visual . . . Grooves melted into the base metal on the inside surface of the pipe adjacent to the stringer bead and left unfilled by the weld deposit.

Radiograph . . . A dark, irregular line or connected spots located on either or both sides of the stringer-bead image. IUC resembles SL except it is more irregular, somewhat wider, and the outer extremities are less dense.

Acceptability (Pipeline) . . . Any IUC shall not exceed 3 in. in length, and not have more than 3 in. of IUC in any 12 in. of weld. Parallel IUC's shall be considered as separate defects. Individual IUC areas shall be separated by at least 5 in. of sound metal. No weld shall contain more than 6 per cent IUC in the linear length of the weld. Any weld containing IUC the gammagraph of which indicates a depth of over one-eighth the thickness of the parent metal will not be accepted. **(Compressor station) . . .** Any IUC shall not exceed 1½ in. in length and not have more than 1½ in. of IUC in any 12 in. of weld. Parallel IUC shall be considered as separate defects. Individual IUC areas shall be separated by at least 8 in. of sound metal. No weld shall contain more than 4 per cent IUC in the linear length of the weld. Any weld containing IUC the gammagraph of which indicates a depth of over ⅛ the thickness of the parent metal will not be accepted.

INTERNAL BEVEL (IB). — Regular shaped grooves on inside surface of pipe adjacent to the stringer bead.

Characteristics, visual . . . Inside sharp edge of pipe end is rounded or shaved off leaving a furrow in the parent

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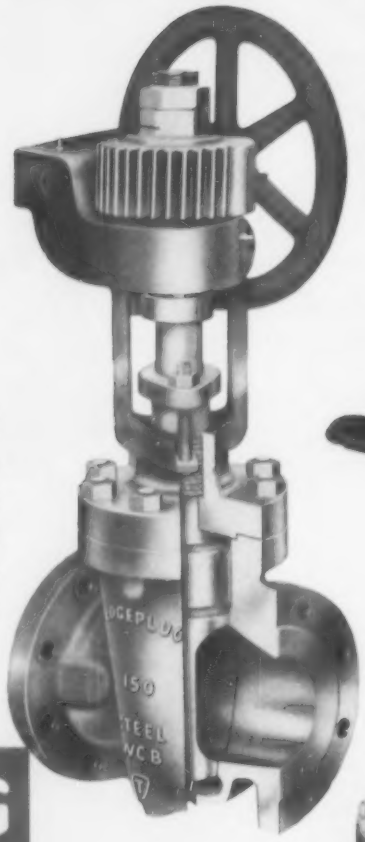

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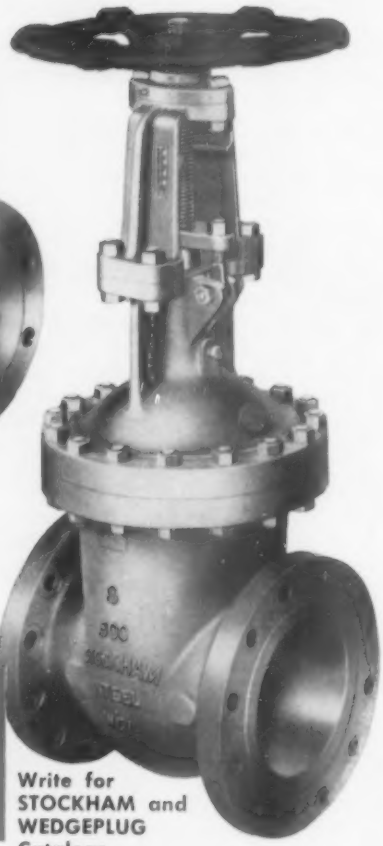

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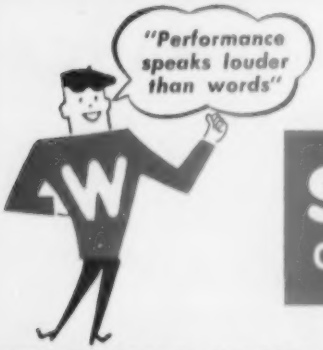

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metal adjacent to and paralleling the protruding weld deposit.

Radiograph . . . A dark uniform area paralleling the stringer bead in the weld image of the radiograph. IB usually appears on one side at a time. This defect is similar to IUC insofar as its outer edge is less dense, but IB has greater uniformity.

Acceptability . . . Any IB shall not exceed 1/32 in. in depth nor shall there be more than 3 in. of IB in any 12 in. of weld. No weld shall contain more than 8 per cent IB in its linear length.

SKIP CRACK (SCr).—A former crack in the hot pass that, except for scattered spots, has been welded or burned out by the third pass.

SKIP CRACK

Characteristics, visual . . . Elongated slag-filled voids in the stringer bead hot-pass portion of the weld and centered in the weld at that point.

Radiograph . . . Dark lines varying in length from minute spots to several inches long located at the center of the stringer-bead image of the radiograph. The short, dark lines are normally straight, but the longer ones will have the crack characteristics. **Note:** Skip crack is a term applied to this particular defect mainly to inform the pipeline company that cracks have occurred in the welding operation.

Acceptability (Pipeline) . . . No weld shall contain more than 6 per cent SCr and there shall not be more than 2 in. of SCr in any 12 in. of weld. Individual defects must be separated by at least 4 in. of sound metal. Any SCr over ¾ in. in length will be considered an active crack and dealt with as such. **(Compressor station) . . .** No weld containing SCr will be accepted.

CRATER CRACK (CCr).—A crack in the depression of the arc crater at the termination of a weld bead.

Characteristics, visual . . . A fracture of the thin weld deposit in the crater of the stringer bead.

Radiograph . . . A dark line in the stringer bead image of the radiograph. This dark line may appear at any point where the stringer-bead image is broken, or where the weld deposit was interrupted. The dark line may appear with any of the crater defects. Extreme CCr will progress through or from a crater and along the stringer-bead image with cracklike characteristics.

Acceptability (Pipeline) . . . No weld containing more than 3 per cent CCr

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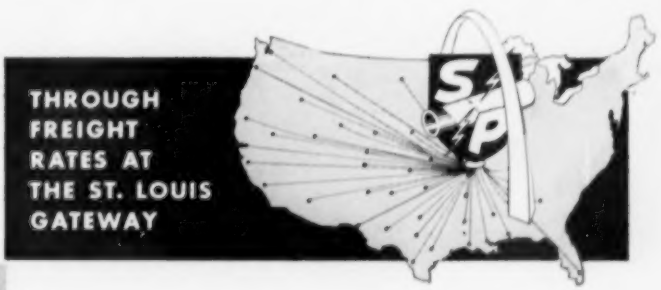

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in the linear length of the weld will be accepted, nor shall there be more than 1 in. CCr in any 12 in. of weld. Individual defects must be separated by at least 8 in. of sound metal. Any CCr over ½ in. in length will be considered an active crack and dealt with as such.

(Compressor station) . . . No weld containing CCr will be accepted.

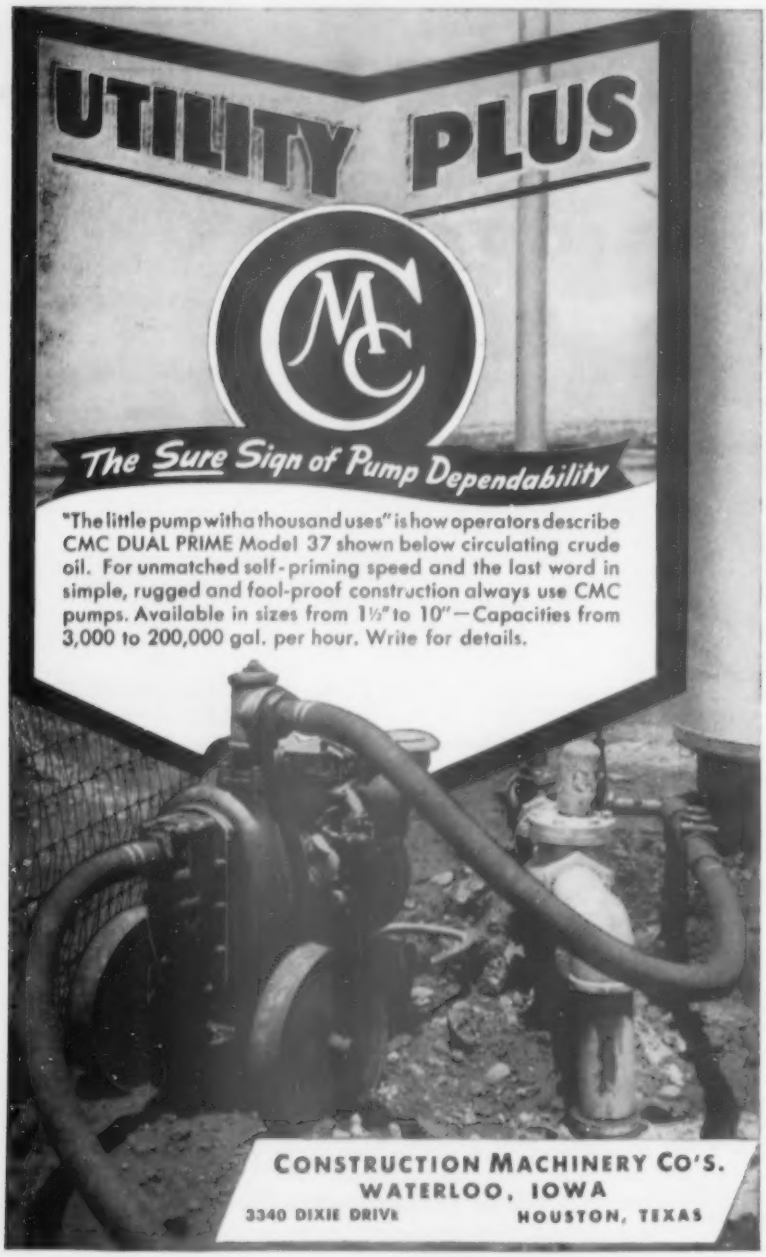
ACTIVE CRACK (ACr).—A fracture in the weldment or weld area.

Characteristics, visual . . . An elongated irregular crevice usually progressing lengthwise of the weldment or its proximity.

Radiograph . . . A dark, irregular line usually progressing lengthwise of the weld image of the film. This dark line is normally in or immediately paralleling the stringer-bead image. In an area where the stringer bead is rough and broken, the dark line will go from one side to the other of the stringer-bead image as it progresses, following the line of least resistance.

Cracks may occur anywhere in the weld.

Acceptability . . . No weld containing a crack will be accepted regardless of its length or location.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ROUGH STRINGER (RS).—A stringer bead with the weld metal unevenly penetrated.

Characteristics, visual . . . The penetrated weld metal of the stringer-bead pass is uneven with a series of minor BT's and SBW's connected by excessive deposits of weld metal.

Radiograph . . . The stringer-bead image on the radiograph will have the appearance of a string of beads. There will be a number of light areas (excessive weld metal) connected by dark areas (insufficient weld metal). Minor SL's and LP's will normally appear in the same area with the BT's and SPW's, none of which exceed the recommended limitations.

ARC BURN (AB).—Crater and scar on the outside surface of parent metal near the weld.

Acceptability . . . There should not be more than 12½ per cent of RS in the linear length of the weld.

Characteristics, visual . . . A crater burned into the parent metal near the weld. The crater usually has a scar extending toward the weld. The scar is normally accompanied with spasmodic weld deposits.

Radiograph . . . Dark, irregular (horseshoe shaped) spots near the weld image of the film. The point or crater of the AB is usually farthest from the weld and is the darkest. The scar from the crater toward the weld will appear light on the film with dark lines bordering it.

Acceptability . . . Any AB shall not be more than 2 in. in length. Individual AB shall be at least 8 in. apart. No weld shall be accompanied with more than four AB's. Welds with associating AB's containing spider-leg cracks will not be accepted.

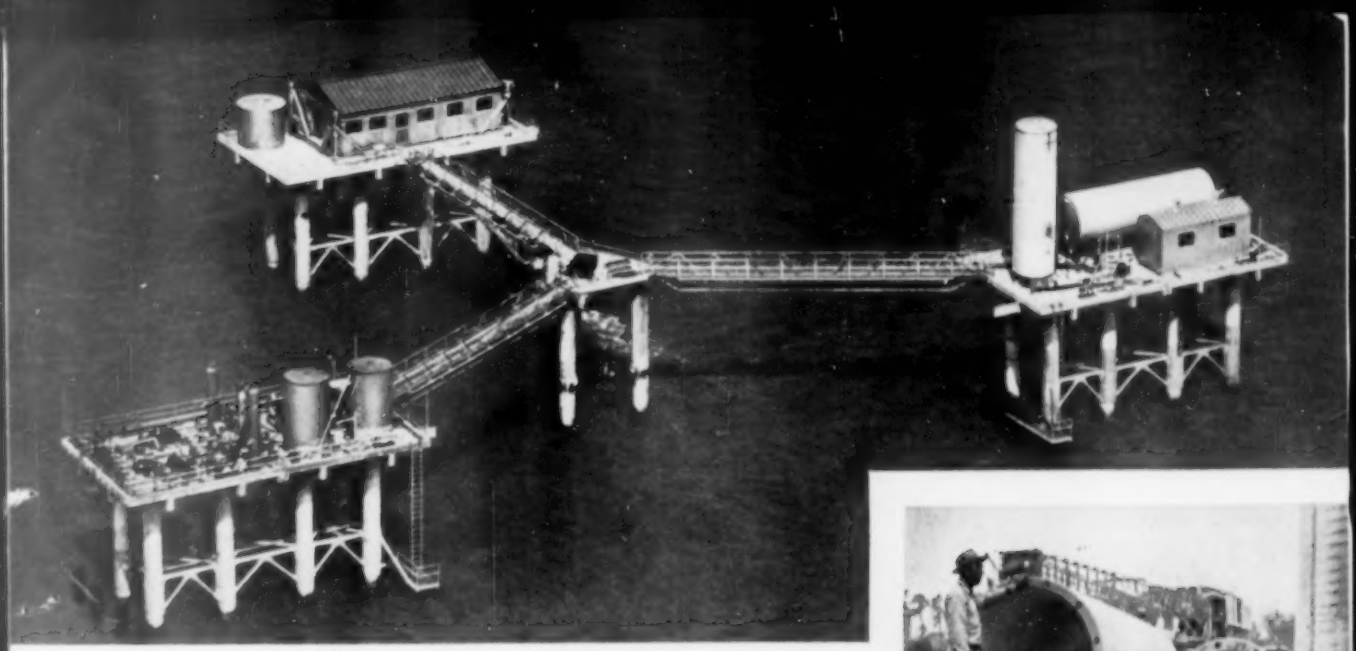
CONCAVE COVER (CC). — Insufficient weld reinforcement. Low crown on cover pass.

CONCAVE COVER

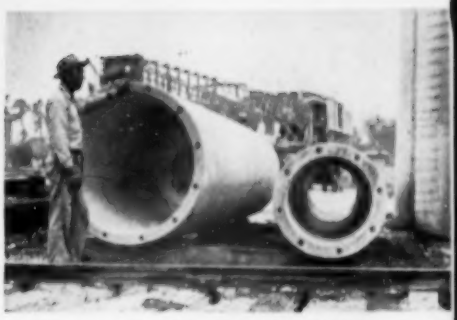
Characteristics, visual . . . The weld metal deposit of the cover pass is low in the center.

Radiograph . . . Dark shaded areas on both sides of the stringer-bead image of the radiograph. It is usually darker near the stringer-bead image, fading gradually to the outer edge of the weld image. CC will cause greater contrast between the stringer-bead image and the rest of the weld image.

Acceptability . . . Any weld with reinforcement lower than the plane surface of the parent metal should be repaired.



Oil production platform in Gulf of Mexico on 36" Raymond Cylinder Piles.



Two typical pile sections.

THE Raymond
PRESTRESSED CONCRETE CYLINDER PILE

Raymond, pioneer in concrete piles, announces its latest construction development, the CYLINDER PILE, which is ideally adapted for use in off-shore projects. This pile is a hollow cylindrical pile of prestressed concrete, manufactured in a series of sections placed end to end and joined together by post-tensioned cables of high tensile steel wire . . .

The advantages over other types of piles are numerous. Prestressed Cylinder Piles have extraordinary structural strength. They are fireproof, corrosion-proof and not subject to attack by marine organisms, thus assuring low maintenance and extremely long life. In addition, their flexibility as to length, diameter and extent of prestressing makes it possible for them to meet a wide variety of design requirements.

SEND FOR BULLETIN CP-1

Assembling of the pile sections. Raymond Cylinder Piles are made in lengths up to 200 feet.

Offices serving the Gulf Coast Area:

837 Common Street, New Orleans 12, La.
610 Woodrow Street, Houston 6, Texas
57 Forsyth Street, N. W., Atlanta 3, Ga.

Raymond
CONCRETE PILE CO.

140 CEDAR STREET • NEW YORK 6, N. Y.

digs 17¾ feet deep . . . dumps at 8¾ foot height

With its long, deep reach, Koehring ½-yard 205 hoe digs 17¾ feet below grade . . . has 8′ 9″ clearance height at beginning of dump to load trucks. Maximum cutting width, with side cutters, is 31 inches. During the hoist-and-swing cycle, close-coupled dipper pulls up tight to boom, avoids spillage. Powerful cable crowd, fast line and swing speeds maintain big-yardage production. Heavy-duty, box-section boom and dipper arm resist side-sway in toughest digging. Operators like the 205's ease of operation . . . *you'll* like its EXTRA WORK CAPACITY. Here are some of the heavy-duty advantages you get that increase production with every 205 attachment:

Big 20-inch main drum clutches.

Only 2 major shafts in upper machinery . . . simple, accessible.

Heavy-duty splined shafts . . . carburized, hardened gears.

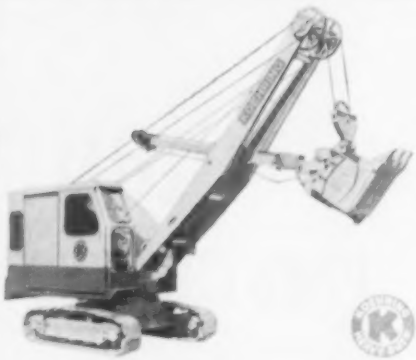
4 hook-rollers, eccentric adjustment.

Automatic crawler traction-brakes.

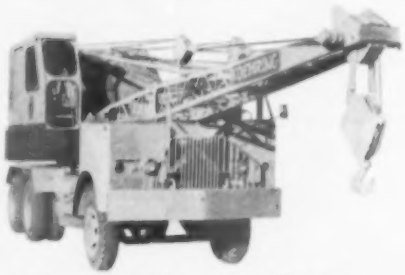
Standard or extra-long crawlers . . . with 16, 20, or 24-inch shoes.

Independent traction . . . optional.

Antifriction power-flow for dig, hoist, swing, travel.



Crawler-mounted 205 brings you: ½-yard dipper capacity as a shovel or hoe . . . ½ to ¾-yard bucket capacity as a clamshell or dragline . . . 10-ton lift crane.



Truck-mounted 205 has 15 tons lift capacity, 25 to 55-ft. boom, plus max. 30-ft. jib. Travels 32½ m.p.h. Converts to all standard excavator, crane attachments.

Get the complete story on this new 205. Ask your Koehring distributor for details, or write for bulletin.

To: KOEHRING CO., Milwaukee 16, Wis.

Send us bulletin on the new ½-yard, 15-ton 205.

NAME _____ TITLE _____

COMPANY _____

STREET _____

CITY _____ STATE _____

(A)

KOEHRING

COMPANY • Milwaukee 16, Wis.

Subsidiaries: PARSONS • KWIK-MIX • JOHNSON

EQUIPMENT MEN . . . in the News

Le Roi Names J. E. Heuser As Sales Vice President

J. E. HEUSER

Jack E. Heuser has been made vice president in charge of sales for Le Roi Co., according to T. O. Liebscher, president. Heuser will be responsible for the organization and management of a newly created sales division which will sell and service all Le Roi products.

Heuser joined Le Roi in 1939. In 1941 he became a member of Ampco Metal sales organization and served as manager of the Pittsburgh district, and later the Los Angeles district. In 1946 he rejoined Le Roi as assistant to the general sales manager. In accepting the new position, Heuser vacates the post of engine division sales manager.

Thornhill-Craver Appoints O'Neil to Houston Area

W. C. (Bill) O'Neil has been appointed sales representative in the Houston territory for Thornhill-Craver. He will cover the East Texas and Gulf Coast areas. O'Neil has had a number of years' experience in the oil-equipment field. He was a sales representative for Gulf Supply Co. for 3 years prior to joining Thornhill-Craver, and was in the engineering department of W-K-M for 5 years.

Denver Bank Forms New Oil and Gas Department

The formation of a new oil and gas department, with Marvin F. Owens in charge, has been announced by Elwood M. Brooks, president of Central Bank & Trust Co., Denver. Owens has been named a vice president of the bank to head the new department.

Owens comes to Central with a wide background of petroleum experience, having been associated with Bay Petroleum Corp. for the past 8 years as chief petroleum engineer and assistant general production superintendent. Prior to that he was connected with British-American Oil Producing Co.

The new oil and gas department at Central Bank provides a complete financial and banking service for the rapidly growing oil industry in the region.

Personnel Promotions Made By Stewart & Stevenson

A number of personnel promotions in Stewart & Stevenson Services, Inc., branches throughout Texas have been announced by Joe Manning, vice president and general manager. These changes have been made to improve service to the customer and increase the engineering and application ability of Stewart & Stevenson sales organization.

E. E. Childress, who has been sales manager of the Odessa, Tex., branch for the last 3 years, has been transferred to the main plant at Houston where he will serve as chief engineer. Childress has been with Stewart & Stevenson for 8 years.

N. J. Herman has been transferred from the engineering department in Houston to the petroleum-industry sales department for the Houston territory.

Grady Foster has been transferred to the Lubbock, Tex., branch where he will be sales manager. He was formerly in the sales department of the San Juan, N. M., branch.

Johnston Testers Export Office Moves to Houston

W. F. (Bill) Bettis, vice president in charge of export sales for Johnston Testers, announced recently that the export sales offices of the company would be moved from Los Angeles to Houston effective September 1.

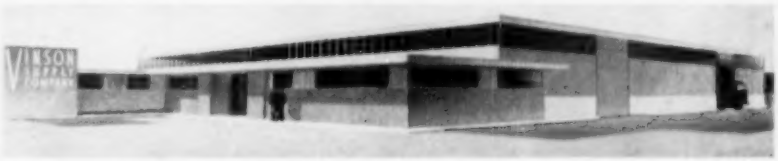
Bettis, who has been in charge of Johnston's export sales since 1934, stated that with enlarged home-office facilities, such a move is in line with company policy to locate all personnel in its new building in Houston.

Reilly Tar & Chemical Opens New Houston Office

Announcement has been made of a new Houston sales office of Reilly Tar & Chemical Corp. by J. H. Barnett, Jr., general sales manager of the company.

Reilly Tar & Chemical's new office, now one of three in Texas alone, is equipped to handle the sale of coal-tar enamels, chemicals, creosoting materials, road tars, roofing, waterproofing, and other Reilly products.

Vinson Supply Announces Office, Building Expansion



Vinson Supply Co. store now under construction at Amarillo, Tex.

To keep pace with the growing demands of the oil industry in the Mid-Continent area, Vinson Supply Co. has engaged, in the past year, in a program of major expansions of buildings and facilities, according to Vinson officials at the firm's headquarters in Tulsa.

The last project on this program, now under construction, is the new warehouse and office building at Amarillo, Tex. Most recently completed is the new steel and aluminum warehouse and office building at Dallas.

In Tulsa the pipe-warehousing space has been doubled, and in Odessa, an additional warehouse has been added to the warehouse and office building.

Vinson officials stated that the enlarged warehousing facilities will enable Vinson to carry complete stocks of Ladish welding fittings and flanges, Fisher controls, Nordstrom valves, Crane valves, National Tube products, and Chase brass tubes.

In other moves, Vinson has opened a sales office at Oklahoma City with George McDannold as manager. Vinson already has a similar sales office lo-

C-R-C A REVOLUTIONARY

FOR INTERNAL CLEANING . . .

LINE

The heart of the C-R-C internal cleaning and coating machine is this head which rotates at 250 rpm. The wire brushes clean the pipe and corrosion-resistant coating is sprayed from the guns at the left.

This over-all view shows the rotating head and the shaft which drives it through the pipe.

The rotating head enters the pipe after it has been clamped on the rack to begin the cleaning-coating operation.

This tractor drives the cleaning head through the pipe. Coating for the spray guns is in the tank in front of the operator.

Increased production through improved flow in your pipelines is now possible with the use of C-R-C's revolutionary new internal cleaning and painting machine. This new machine cleans the interior of the pipe and coats it in one automatic operation. Internal cleaning gives a smooth abrasion-resistant surface resulting in reduced turbulence and friction for substantially increased flow.

After the cleaning operation the machine coats the interior with a corrosion-resistant Epon* resin paint, developed in cooperation with Coast Paint & Lacquer Co., Inc. The unit is designed to provide pipe joints with this smooth interior surface and protective coating when they are received from the mill. Its use is also recommended on pipe that has been in storage for long periods to remove rust and corrosion before it is laid.

The new unit is an EXCLUSIVE* development of C-R-C. It is completely portable and can be used for stationary or on-the-job installations. The cleaned and coated, abrasion-resistant surface is desirable for use in gas pipelines as well as products and crude-oil lines. Consult C-R-C on this new pipeline development for improving production in your lines.

*Patent pending

C-R-C

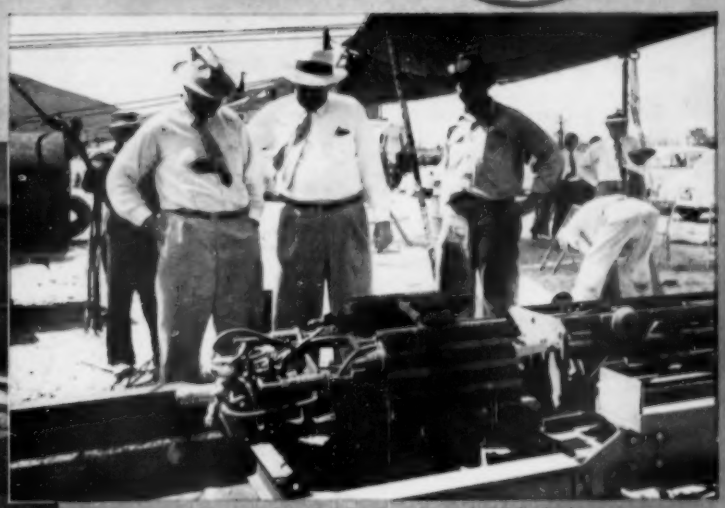
CRUTCHER • ROLFS • CUMMINGS, INC.

7825 KATY ROAD, HOUSTON, TEXAS • TULSA, OKLAHOMA

C-R-C has been first with every major development in pipeline equipment

DEVELOPMENT AND COATING OF PIPE

A supply of 5-gallon cans of special "Copon" formulated for C-R-C pipe application.



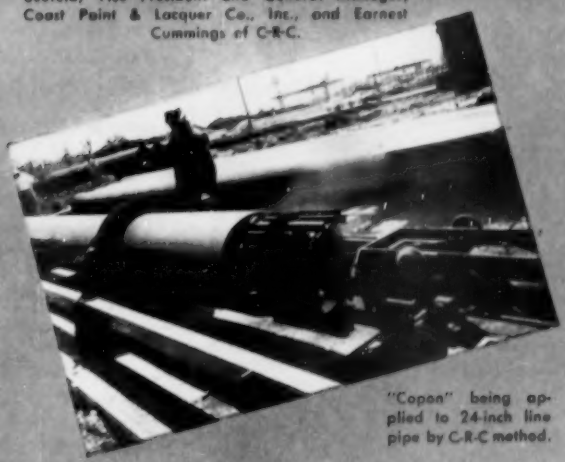
Left to right – Jim D. Cummings of C-R-C, Carl Seefeld, Vice President and General Manager, Coast Paint & Lacquer Co., Inc., and Earnest Cummings of C-R-C.

"COPON" . . . our Epon® resin coating is used by C-R-C for protection and preservation of line pipe.

Our chemists and engineers – working for weeks in close association with Mr. Jim Cummings – have developed and perfected the special "Copon" formula for the coating used in the revolutionary new C-R-C line pipe cleaning and coating process.

"Copon" adds years to the life and usefulness of line pipe.

- It assures installation of rust-free pipe.
- It has exceptional tenacity, will adhere to metal surfaces longer and under more difficult conditions than any other coating yet tested.
- It is abrasion-resistant and has proven low erosion rate.
- It gives positive protection against rust and corrosion, also the chemical effects of crude oil, natural gas and salt water.
- It has amazing flexibility and elasticity.
- It provides a silky smooth, even surface that increases line flow by reducing friction.



"Copon" being applied to 24-inch line pipe by C-R-C method.

Above the business end of C-R-C cleaner and "Copon" application.

COAST Paint & Lacquer Co. Inc.

P. O. Box 1113 Houston, Texas

Specializing in Protective Coatings and finishes for Industry

HILCO

LUBE and FUEL OIL PURIFICATION . . .

GET RID OF DIRTY OIL . . .
GET LOWER OPERATING COSTS
LONGER EQUIPMENT LIFE

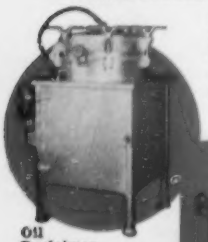
HILCO oil purification means complete oil purification! With a HILCO you get removal of sludge, acids, carbon, water and fuel dilution economically and efficiently. HILCO operation is continuous, all-electric and automatic.

Clean oil at all times reduces down time, increases production and HILCO units pay for themselves in savings.

HILCO offers a wide range of oil purification units . . . one to meet your needs. Write us about your equipment . . . and get recommendations at no obligation.

● *THERE'S A* **HILCO** *FOR EVERY LUBRICATION AND FUEL OIL FILTERING PROBLEM*

HILCO has 25 years experience in oil purification. Let this experience work for you.



Oil Reclaimer

Filter

PURIFIERS
FILTERS
RECLAIMERS
CONDITIONERS

A complete range of sizes and systems for oil purification.

★ *WRITE FOR* **FREE** *LITERATURE*
NO OBLIGATION ON YOUR PART

THE HILLIARD CORPORATION
23 W. FOURTH ST.
ELMIRA, N. Y.

IN CANADA — UPTON-BRADEEN-JAMES, Ltd.
890 Yonge St., Toronto, 5464 Park Ave., Montreal

cated in Kansas City. It was also announced that L. O. Barnett, formerly with Vinson, has returned as manager of inside Fisher control sales in the Tulsa office.

Security Makes Gearhart Top Head Regional Engineer

M. GEARHART

Marvin Gearhart has been named to the post of head regional field engineer for Security Engineering Division, one of the Dresser Industries. Ken Swart, vice president and chief engineer of Security, made the announcement. In his new post, Gearhart will supervise Security's network of regional field engineers serving the drilling industry in the Mid-Continent, Rocky Mountain, and Canadian oil fields.

Gearhart, who is making his headquarters in Fort Worth near Security's new 20-acre Dallas plant, first joined Security in 1953. Prior to his recent promotion he was Security's chief regional field engineer for the western region.

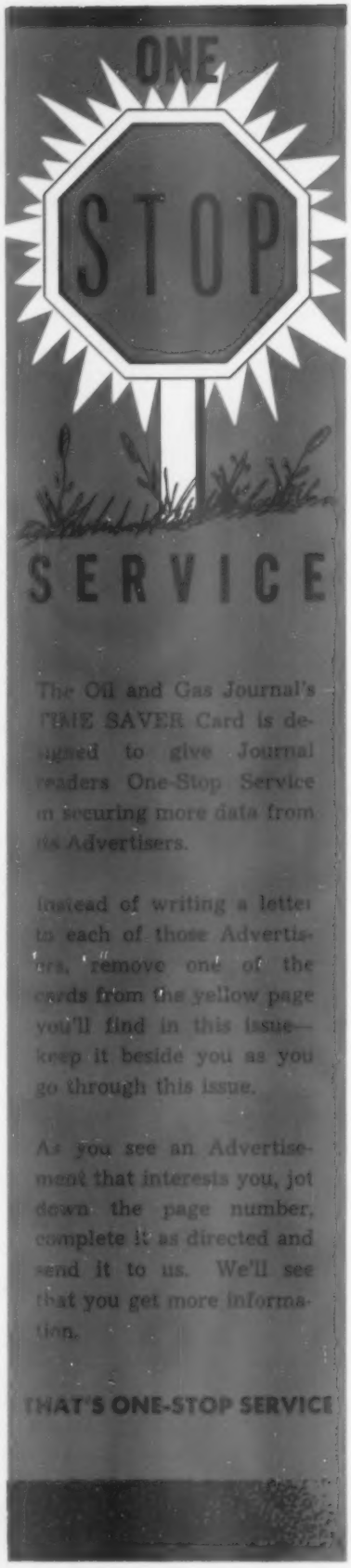
Three Lane-Wells Officials Named to New Positions

John J. Neale has been named president, Rodney S. Durkee, chairman of the board, and Walter T. Wells, founder-chairman of Lane-Wells Co., it has been announced. The board of directors has been increased to 11, and John J. Neale has been made a new director, leaving one vacancy to be filled.

Neale, who has been assistant to the president for the past year, started work for the company as a loader in Houston in 1936. He has been a helper, perforating operator, operator-in-charge, subdistrict superintendent, division sales engineer, district superintendent, Gulf Coast division sales manager for 2 years, and Gulf Coast division manager for 6 years.

Durkee joined Lane-Wells in 1938 as executive vice president after nearly 23 years in an executive capacity with major oil companies. In 1939 he was made president, and the company has grown from a comparatively small concern at that time to a world-wide organization with nearly 100 branches. As chairman he will have general supervision over company activities.

Wells was co-founder of the company in 1932 and met and solved many challenging problems during the initial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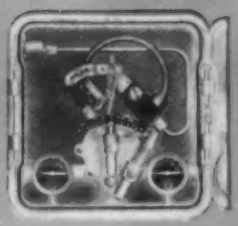
SERVICE
The Oil and Gas Journal's TIME SAVER Card is designed to give Journal readers One-Stop Service in securing more data from its Advertisers.
Instead of writing a letter to each of those Advertisers, remove one of the cards from the yellow page you'll find in this issue—keep it beside you as you go through this issue.
As you see an Advertisement that interests you, jot down the page number, complete it as directed and send it to us. We'll see that you get more information.
THAT'S ONE-STOP SERVICE

For Precise Accuracy...Quality of Manufacture... And Outstanding Performance...

Vent Valves



Pressure Controllers

Liquid Level Control Pilots

Diaphragm Control Valves

Supply Regulators

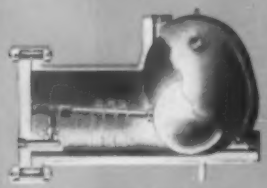
Specify BS&B "Climax" Controls And BS&B Safety Heads!

BS&B "Climax" Controls and BS&B Safety Heads are world-renowned among men in the Process Industries for their precise accuracy, superior quality and outstanding performance! Manufactured to the most exacting tolerances to comply with today's and tomorrow's newest concepts of automatic safety and process controls, they should be your *first choice* when specifying equipment for a new installation, or for replacement purposes. Call in your BS&B Representative —or write for detailed information!

BS&B Service Is Close To You!

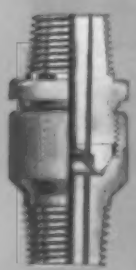
★ *84 Sales Centers* ★ *40 Stocking Points*

Pressure Reducing Regulators



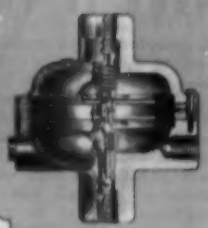
Continuous Drainers

Liquid Level Controllers

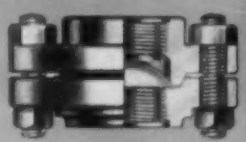


Screw Type Safety Heads

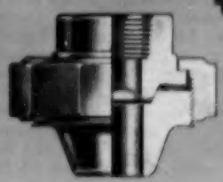
EFFICIENCY OVER 60 YEARS BS&B RELIABILITY



Relay Regulators



Bolted Type Safety Heads



Union Type Safety Heads

BLACK, SIVALLS & BRYSON, INC.

Climax Controls Division, Dept. 4-A9

7500 East 12th Street Kansas City 26, Missouri

stages of the company's operations. He was president until 1939 and has been chairman of the board until the present.

The new post of founder-chairman will allow the company to continue benefitting from his experience.

C. Lee Cook Holds Sales Meeting

C. Lee Cook Manufacturing Co., of Louisville, Ky., recently held a sales meeting at its home office and plant, playing host to sales representatives from six cities. In addition to panel discussions on Cook products, sales opportunities, and sales problems, there was a full-dress factory tour, designed as a refresher course for Cook representatives on the company's manufacturing techniques and facilities. Attending were, front row: Arthur Rumsey, Los Angeles; W. P. Mayo, Houston; Joseph C. Buerkle, New York City; Fred D. Durham, president, Louisville; Foster Black, Amarillo, Tex.; C. J. Kremer, Jr., chief engineer, Louisville; and M. A. Boulden, Philadelphia. Middle row: Earl Friedrich; R. J. Pohlmann; C. E. Hegewald; Ray Eyl; William Probst; P. W. Mettling, vice president, all of Louisville; and Joseph Lepic, Chicago. Back row: Phillip Kleinhenz; C. T. Duke; Charles Corcoran; Tom Furlong; Walter Rains; John E. Scoggan, assistant sales manager; and B. G. Steitz, all of Louisville.

Oilwell Plans Enlargement Of Garland Facilities

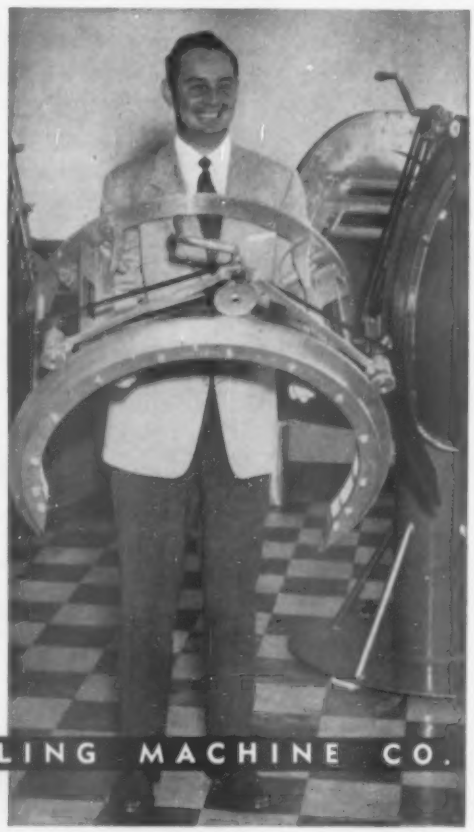
Oil Well Supply Division of United States Steel Corp. has announced plans for enlarging its central-warehouse and modification-center facilities at Garland, Tex. The announcement was made by Fred F. Murray, president of Oilwell, who stated that the facilities built at Garland in 1950 have proved inadequate, and that present plans call for more than doubling the size of the present building.

Oilwell's present Garland plant, completed in December 1950, has served as central stocking point for Oilwell's southwestern operations and has provided certain assembly and modification facilities.

The Garland plant is located on an 83-acre tract of land on the west edge of the city of Garland and is served by a spur from the main line of M-K-T Railroad.

Oilwell manufactures a complete line of oil-field drilling and producing ma-

H & M PIPE CUTTING AND BEVELING MACHINES NOW 40% LIGHTER!



HERE IS THE AMAZING STORY . . .

A completely new manufacturing process has made it possible to drastically reduce the weight of the renowned H & M Pipe Cutting and Beveling Machine. The search for a light, tough metal was started many months ago in an attempt to make the H & M line the lightest in its class without destroying any of its famous accuracy, long life, or economy. After months of searching, a satisfactory process was finally encountered. The H & M test model was rigged to an electric motor and the torch arm automatically sent around the pipe over 25,000 times. During the test, sand and other abrasive materials were blown into the highly machined gears, and the machine exposed to a multitude of simulated weather conditions. A micrometer check following this torturous test showed NO WEAR ON THE GEARS.

Here are the amazing new weights of the H & M Pipe Cutting and Beveling Machine: #3 machine — 14" to 20" pipe formerly 89½ lbs now 53 lbs.; #4 machine — 22" to 26" pipe formerly 123 lbs. now 66 lbs.; #5 machine — 28" to 36" pipe formerly 155 lbs. now 95 lbs. (all weights are approximate).

THE H & M . . .
Lightest in its Class!

H&M PIPE BEVELING MACHINE CO.

U. S. Trademark Reg.

311 EAST THIRD, TULSA, OKLA.
PHONE 3-0241

"SPUDDING IN" ON 51ST STREET

Even though hole is finally made in Southwest United States or in neighboring Canada, initial planning and financing may well have taken place in the heart of Manhattan.

The modern building of the Empire Trust Oil and Gas Department at Rockefeller Center houses an oil banking and advisory staff exclusively concerned with the financing problems of your industry. If you want expert advice on financial matters, or need funds to carry out worthwhile projects, come to the Empire Trust Company. We're here to serve you.

Empire Trust Company

OIL AND GAS DEPARTMENT

7 West 51st Street at Rockefeller Center

New York City

MEMBER FEDERAL DEPOSIT INSURANCE CORPORATION

How to get the best life/cost ratios in your tube steels: *Ask the experts!*

This month's report is on: **18-8 STAINLESS**

An austenitic, non-magnetic alloy that shows the best combination of creep strength, oil corrosion resistance and oxidation resistance for service up to 1500°F. For use in oil cracking systems, hydrogenation equipment, high temperature oil and steam piping, superheater elements, heat exchangers.

ONE OF 24 TIMKEN HIGH TEMPERATURE STEELS

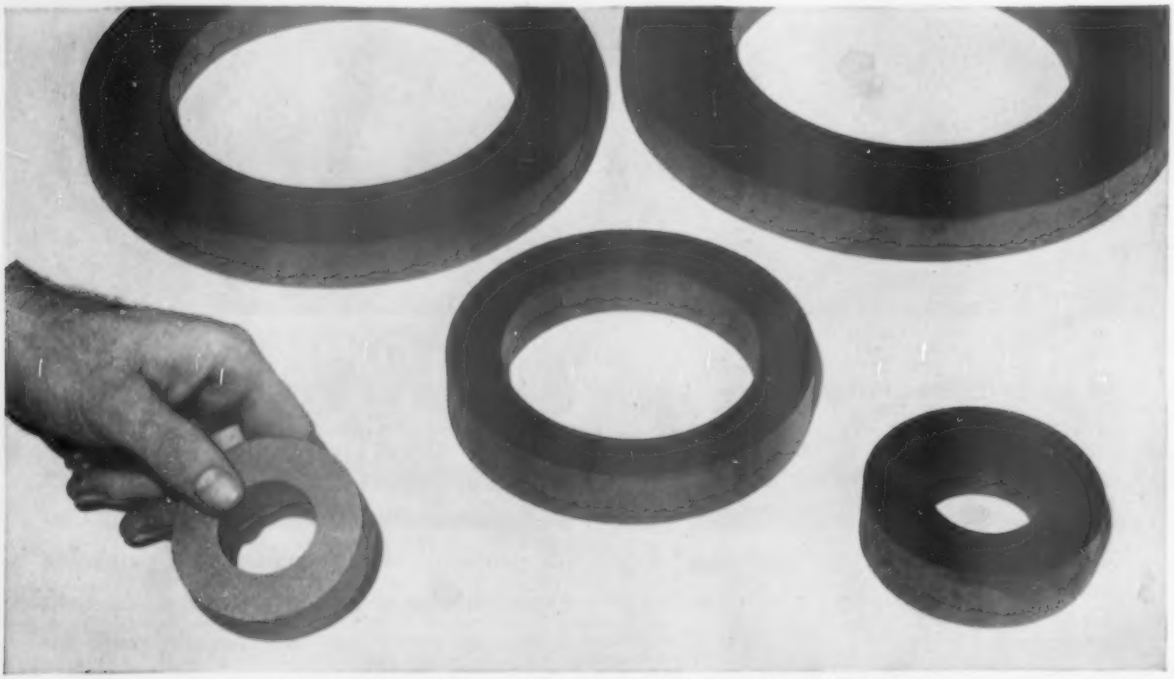
Carbon	Sicromo 2	Sicromo 5S	18-8Ti
Carbon-Mo.	Sicromo 2½	Sicromo 5MS	16-13-3
DM-2	2½% Cr.-1% Mo.	Sicromo 7	25-20*
Silmo	Sicromo 3	Sicromo 9M	23-12*
DM	4-6% Cr.-Mo.	18-8 Stainless	35-15**
2% Cr.-Mo.	4-6% Cr.-Mo.-Ti.	18-8 Cb	16-25-6**

* *Available as seamless tubing on an experimental basis only.*
** *Not available as seamless tubing.*

PROBABLY you can find several high temperature tube steels that will solve your heat, pressure, corrosion or oxidation problems. But, there's only one that will give you maximum tube life per dollar—the best life/cost ratio.

Give Timken company metallurgists the problem of finding this steel for you. They're the experts. With years of steel research and experience, they can help you select *your* best steel from 24 different analyses. You'll be sure of getting the tube steel with the best life/cost ratio. And regardless of which analysis you select, you'll be assured of uniform quality because the Timken Company rigidly controls quality from melt shop through final inspection.

Got a tube problem? *Ask the experts!* The Timken Roller Bearing Company, Steel and Tube Division, Canton 6, Ohio. Cable address: "TIMROSCO".



Timken heavy-wall pressure tubing is available in sizes up to 10½" O. D.

YEARS AHEAD—THROUGH EXPERIENCE AND RESEARCH

SPECIALISTS IN FINE ALLOY STEELS, GRAPHITIC TOOL STEELS AND SEAMLESS TUBING

chinery and equipment in plants located at Oil City and Braddock, Pa.; Kansas City, Mo.; and Long Beach, Calif. A network of 114 field stores and sales offices provides Oilwell customers with service in 34 states and 4 Canadian provinces.

Gardner Named Chairman of TEMA's Technical Group

K. A. GARDNER

Karl A. Gardner has been appointed chairman of the technical committee of Tubular Exchanger Manufacturers Association. Gardner, who succeeds the retiring Sigmund Kopp, is chief engineer of The Griscom-Russell Co., Massillon, Ohio. Gardner joined Griscom-Russell in 1936 and was appointed chief engineer in 1952.

Bonney Makes Bader Sales Engineer at Houston

ROBERT BADER

Robert Bader has been appointed sales engineer at Houston for the welding fittings division of Bonney Forge & Tool Works, Allentown, Pa. Announcement of the appointment was made by Joseph M. Potts, sales manager of the welding fittings division.

Prior to his assignment to Houston, Bader served with Bonney's eastern sales division.

Du Mont Communications Expands Oklahoma Sales

The Mobile Communications Department of Allen B. Du Mont Laboratories, Inc., has expanded its sales activities to cover the northeastern Oklahoma area with the appointment of C. S. Perreault, of Bud Perreault Electronics, Inc., Tulsa, as its sales and service representative. C. J. Harrison, sales manager of the department, announced the appointment.

Perreault will supervise sales, installation, and service of Du Mont's two-way mobile-radio-communication systems in oil-industry installations, trucking operations, and a variety of other activities where mobile equipment is used.

The Perreault organization is one of the leading mobile radio sales and

For Tops in Pipe Wrench Performance...it's the Genuine

RIDGID

...with the guaranteed trouble-free housing!

Only the RIDGID has a world-wide rep as the finest pipe wrench made. Only RIDGID has earned and maintains this rep by building toughness and smart performance into these overwhelmingly popular wrenches, checking them part by part and *hard work testing every last one* before shipment. When you buy a RIDGID, you know the housing won't break, the jaws won't slip or lock, the adjusting nut spins easily to all sizes, 6" to 60". Always most for your money—ask your Supply House.

Have you tried the new RIDGID Spud Wrench?

Deep narrow jaws for close work—break-proof housing — famous RIDGID jaw suspension — comfort-grip I-beam handle. Ask your Supply House.

THE RIDGE TOOL COMPANY, ELYRIA, OHIO, U. S. A.

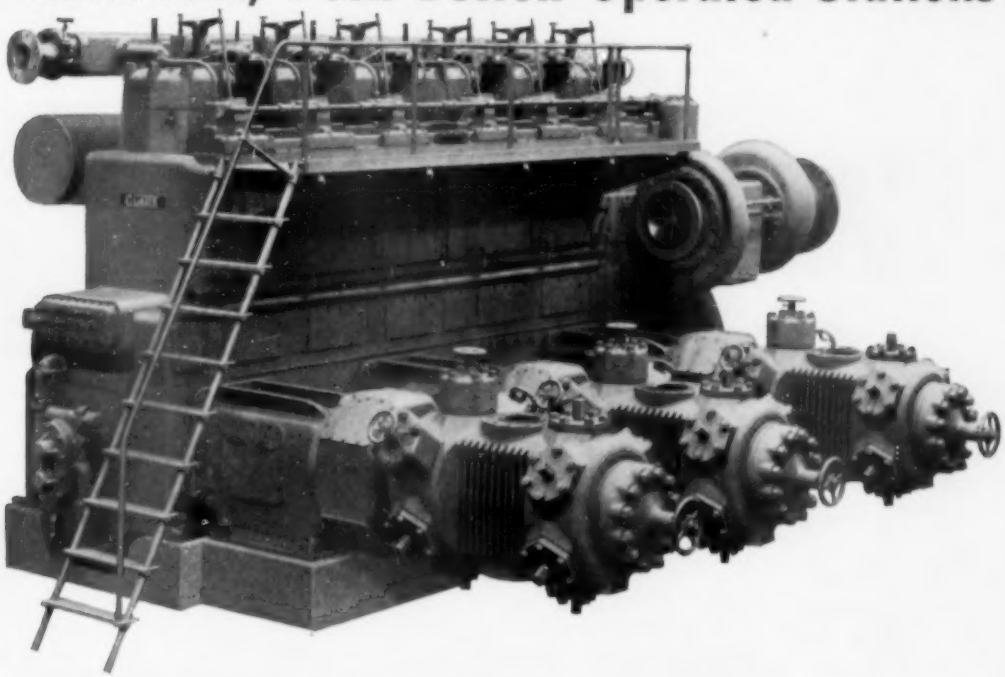
RIDGID

Work-Saver Pipe Tools

Here's the pattern for gas transmission pipeline compressor stations of the future!

NEW GULF INTERSTATE SYSTEM

Selects the Clark Turbocharged Model TLA-6 for its Automatic, Push-Button Operated Stations



ONE MAN/SHIFT/STATION is all that Gulf Interstate will require to operate each installation of four Clark Model TLA-6, 2000 bhp Turbocharged Gas-Engine-Driven Compressors. Air-cooled, high efficiency, pipeline compressor cylinders assure maximum gas thru-put.

It's already an accepted fact that the Gulf Interstate Gas Company has changed the pattern for natural gas transmission with its one man, push-button controlled, automatic compressor stations.

With such advanced thinking, it's only natural that Gulf Interstate will be the first to use the NEW Clark Model TLA, 2000 bhp, Turbocharged Compressors in conjunction with their newly developed system of controls.

Gulf Interstate's control devices for automatic operation of these Clark Compressors did not appreciably increase the installed cost.

If you're interested in a compressor station that can be operated with the highest possible efficiency — *automatically* — while still maintaining station-loading flexibility, be sure you investigate Clark Models TRA and TLA Compressors. There are 8 sizes in a range of 825-3300 bhp. Ask your nearest Clark representative for Bulletins 130 and 134.

CLARK BROS. CO. • OLEAN, N. Y.

ONE OF THE DRESSER INDUSTRIES

Sales Offices in Principal Cities Throughout the World

A dozen ways you'll be ahead with Clark TLA's

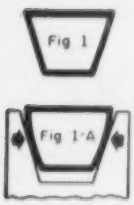
- 7006 btu/bhp/h fuel consumption.
- 40% less cooling required.
- 25-30% lower installation cost.
- Drastic reduction in number of moving parts.
- 90% engine mechanical efficiency.
- Detonation-free operation under all climatic conditions.
- Generous temporary overload capacity.
- Specifically designed for turbocharging.
- Low cycle temperatures for maximum cylinder and ring life.
- Only one turbocharger per unit.
- Unapproached for accessibility.
- 2-cycle simplicity, dependability.

CLARK compressors

Clark sets the pace in compressor progress

to cut your V-Belt costs--

--just make this simple test!



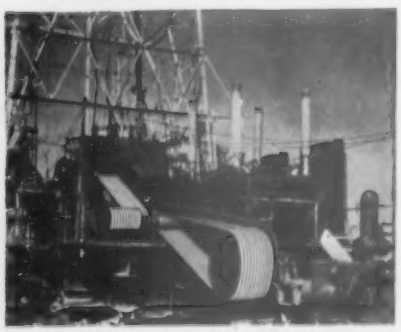
Bend *any* V-Belt that has *straight sides* (Fig. 1). As the belt bends, *feel* the sides *bulge out* (Fig. 1-A). Clearly, the bulging sides are forced to press *unevenly* against the V-pulley—and this *concentrates* the wear at the points shown by arrows (Fig. 1-A). Naturally, this means shorter life for the straight-sided V-Belt.

Now bend the Belt with CONCAVE SIDES...

. . . the Gates VULCO ROPE (U.S. PAT. 1813698) (Fig. 2)

You find that the CONCAVE SIDES *fill out* and become perfectly straight. They thus press *evenly* against the V-pulley (Fig. 2-A). All wear is distributed *uniformly* across the *full width* of the GATES VULCO ROPE— and this means *longer* belt life and *lower* belt costs for you!

When you buy V-Belts, be sure to get the V-Belt with the CONCAVE SIDES... the GATES VULCO ROPE!



Typical Gates Vulco Rope Drive—Gates V-Belts are built with Concave Sides to insure longer belt wear.

Gates VULCO ROPE DRIVES

REG. U. S. PAT. OFF.

THE GATES RUBBER COMPANY
DENVER, U.S.A.

• Gates Engineering Offices and Jobber Stocks are located in all industrial centers of the United States and Canada, and in 70 other countries through-out the world.

CB-940

service companies in Oklahoma, and has installed mobile and base-station equipment of leading manufacturers throughout the Southwest. Officials of the Perreault company are: C. A. (Bud) Perreault, president; C. H. Dunn, vice president; and M. E. Perreault, secretary.

G-E Makes Harmon Area Manager, Communications

N. F. HARMON

The General Electric Co. has announced the appointment of Neal F. Harmon as southwestern regional manager for communication equipment with offices at Dallas. In his new position, Harmon will direct the sale of G-E two-way radio, microwave, and carrier-current equipment in the states of Texas, Arkansas, Louisiana, Mississippi, Oklahoma, and the southeastern half of New Mexico.

Harmon will report to L. Robert Sheeley, manager of sales for General Electric communication products, a unit of the company's commercial equipment department.

Harmon joined General Electric in 1930. Prior to his most recent promotion, he was sales manager of two-way radio equipment with headquarters at Syracuse.

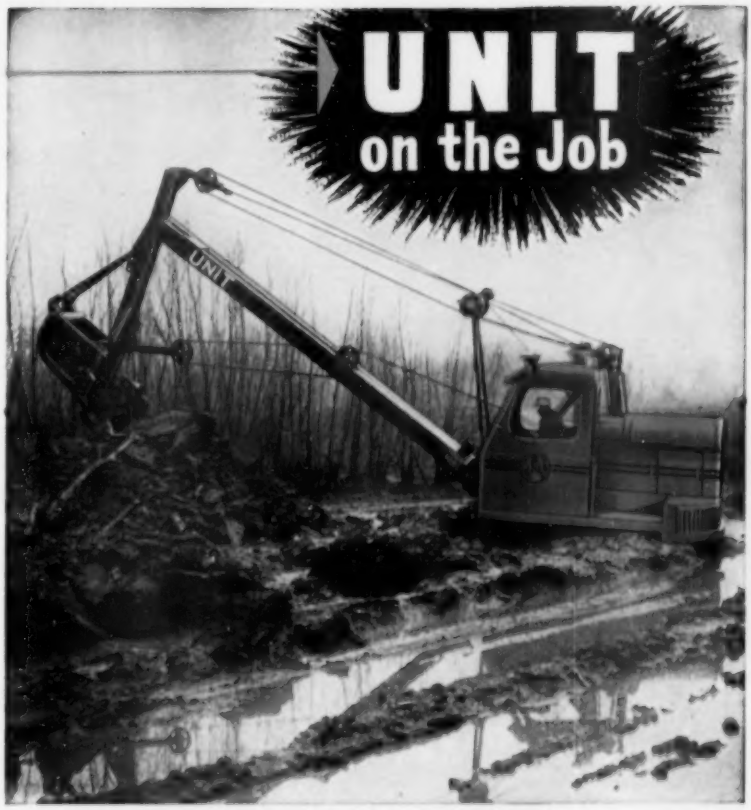
King Appointed Weco Representative in Kansas

LEE R. KING

Lee R. King has been appointed Well Equipment Manufacturing Corp. sales representative for Kansas, according to an announcement by John W. Gates, sales manager. King will make his headquarters in Great Bend, Kans.

King is a geological engineer, having obtained his degree in petroleum geology from University of Oklahoma. Following graduation, King was with The Mayes-Bevans Exploration Co. and later with The Western Geophysical Co. For the past 3 years he has been field sales representative in Seminole, Okla., for Reed Roller Bit Co.

Before assuming his new duties in Kansas, King has completed an extensive program in the Weco plant at Houston, familiarizing himself with the complete line of Weco unions, blocks,



TOUGH GOING . . . and no doubt about it! Here's a UNIT Excavator that's really *IN* but still *ON* the job. Regardless of the swampy ground, there's always plenty of power to provide dependable crawler traction. UNIT machines are designed for just this type of performance under difficult conditions.

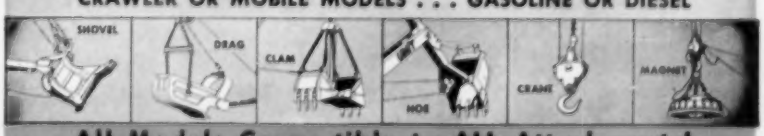
The famous UNIT One-Piece Gear Case assures perfect alignment of all working parts. Twin Hook Rollers . . . Automatic Traction Brakes . . . Interchangeable Disc Clutches plus quality construction make it possible for UNIT to meet the most rigid demands. The streamlined FULL VISION CAB provides maximum visibility in all directions, assuring SAFE and EFFICIENT operation.

A comparison will prove you just can't beat UNIT for SPEED, FLEXIBILITY and TROUBLE-FREE performance at low cost.

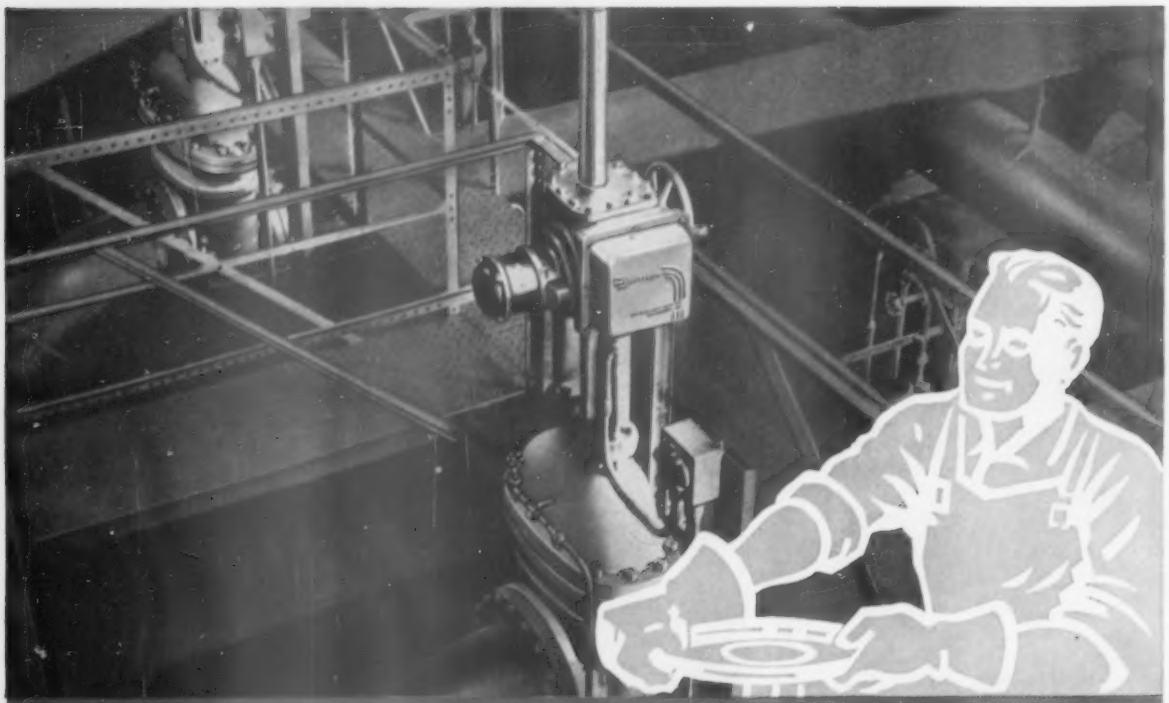
SEE FOR YOURSELF: *Let us send you our novel TV Brochure. It illustrates the complete UNIT line.*

UNIT CRANE & SHOVEL CORPORATION
6327 WEST BURNHAM STREET • MILWAUKEE 14, WISCONSIN, U. S. A.

½ or ¾ YARD EXCAVATORS...CRANES UP TO 20 TONS CAPACITY
CRAWLER OR MOBILE MODELS . . . GASOLINE OR DIESEL



All Models Convertible to ALL Attachments!



this man is never missed

WHEN *Limitorque*® IS USED

The familiar sight of a workman climbing around to open or close valves is unnecessary. . . . Now, he *merely pushes a button* at a conveniently located station or a master control panel. . . . Valves operate quickly, dependably and safely. LimiTorque provides complete safety to workmen, by eliminating the need of climbing to out-of-the-way, hazardous locations for manual valve operation; also vitally important, valve operation parts are protected from damage by the automatic shutting-off of the motor if an obstruction is encountered. LimiTorque may be actuated by any available power source . . . electricity, air, water, gas, or oil.

Thousands of LimiTorques are in daily use, in Power Plants, Water and Sewage Plants, Chemical and Process Plants, Paper Mills, Oil Refineries, Oil and Gas Pipe Lines, —and on Shipboard. LimiTorque Motor Operated Valves are readily adapted to Microwave Control.

Write for LimiTorque Catalog L-54 for further details.

Philadelphia Gear Works, INC.

ERIE AVE. AND G ST., PHILADELPHIA 34, PA.

NEW YORK • PITTSBURGH • CHICAGO • HOUSTON • LYNCHBURG, VA.

Industrial Gears and Speed Reducers
LimiTorque Valve Controls

compounds, Chiksan swivel joints, steel rotary hose, and other company products of these companies.

John Curtin Joins Anchor Sales Staff

J. D. CURTIN

John D. Curtin recently joined the sales staff of Tulsa office headquarters of Anchor Petroleum Co., according to W. A. (Bill) Baden, Anchor president.

Curtin's duties embrace negotiation of sales and buying contracts for refined petroleum products, liquefied petroleum gas, and natural gas. He was formerly associated with Texas Natural Gasoline Corp.

Cardinal Announces Key Promotions at Odessa

Cardinal Chemical, Inc., has announced key promotions in the Odessa, Tex., division office.

J. D. McLaughlin has been promoted from division sales manager to head over-all engineering and equipment. James F. Ormond was moved up from sales and development engineer to replace McLaughlin as division sales manager.

J.D.McLAUGHLIN

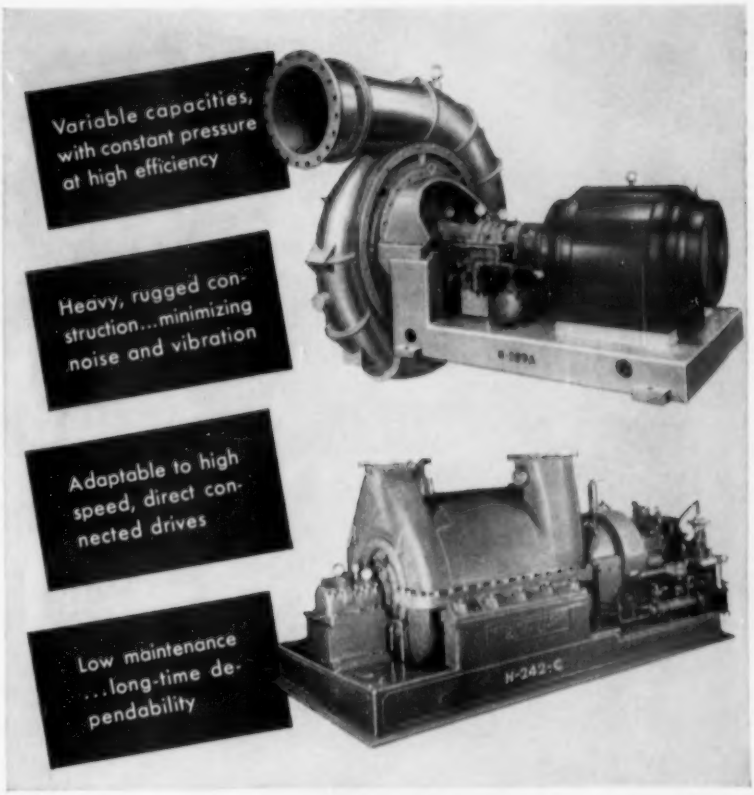
J. F. ORMOND

McLaughlin was graduated from Oklahoma University in 1949 with a degree in general engineering.

Ormond is a graduate of Tulsa University and holds a degree in petroleum engineering granted in 1950.

Westby Starts Tour of Overseas Operations

Gerald H. Westby, president of Seismograph Service Corp., Tulsa, has begun his biannual tour of inspection of the company's overseas operations. He will visit the seismic crews now operating in England and France for Seismograph Service, Ltd., and for Compagnie Francaise de Prospection Sismique, as well as a crew operating for SSC (overseas) in a 75,000-sq. mile project in


Variable capacities, with constant pressure at high efficiency
Heavy, rugged construction...minimizing noise and vibration
Adaptable to high speed, direct connected drives
Low maintenance ...long-time dependability
H-242-C

LOOK FOR THE "BIG 4"

WHEN YOU BUY CENTRIFUGALS

Your specific needs may dictate other important characteristics in centrifugal blowers or exhausters. But even so, these four values are essential to over-all successful performance. You'll find them in every Roots-Connersville Centrifugal Unit, regardless of size. And if you desire variations to suit your application, the ability to meet these needs is a heritage of our 100 years' specializing in equipment to handle gas and air.

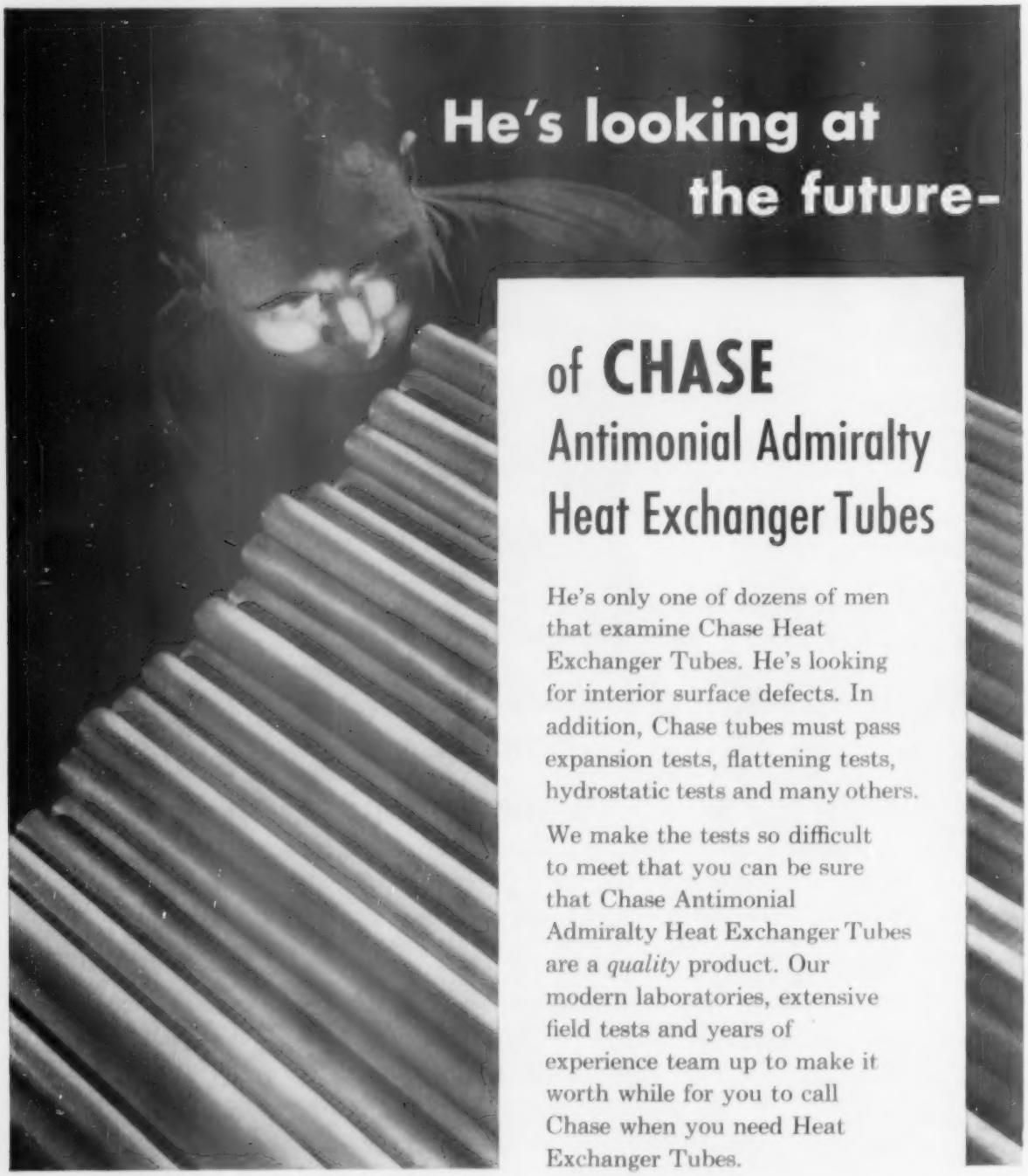
You'll find first-cost economies, too, in the wide range of capacities of R-C Centrifugals. From 2,000 cfm to 100,000 cfm, you can choose the single-stage or multi-stage unit most closely matched to your individual requirements. You can count on the same high quality of performance that has made many thousands of first-time buyers enthusiastic, repeat customers for R-C equipment.

For your present or future requirements, we suggest you call on Roots-Connersville, for 100 years the specialists in handling gas and air.

ROOTS-CONNERSVILLE BLOWER

A DIVISION OF DRESSER INDUSTRIES, INC.
954 Oak Ave. · Connersville, Indiana

Specialists in handling gas and air



He's looking at the future-

of CHASE Antimonial Admiralty Heat Exchanger Tubes

He's only one of dozens of men that examine Chase Heat Exchanger Tubes. He's looking for interior surface defects. In addition, Chase tubes must pass expansion tests, flattening tests, hydrostatic tests and many others.

We make the tests so difficult to meet that you can be sure that Chase Antimonial Admiralty Heat Exchanger Tubes are a *quality* product. Our modern laboratories, extensive field tests and years of experience team up to make it worth while for you to call Chase when you need Heat Exchanger Tubes.

Chase

BRASS & COPPER CO.

WATERBURY 20, CONNECTICUT • SUBSIDIARY OF KENNECOTT COPPER CORPORATION

CHASE WAREHOUSE STOCKS: Houston,* Los Angeles, New Orleans, Tulsa**

*Handled by Standard Brass & Mfg. Co.
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Atlanta	Cincinnati	Detroit	Los Angeles	New Orleans	Providence	Seattle
Baltimore	Cleveland	Houston	Milwaukee	New York	Rochester†	Waterbury
Boston	Dallas	Indianapolis	Minneapolis	Philadelphia	St. Louis	(†sales office only)

Egypt for Egyptian-American Oil Co.

Westby will also visit a seismic project in Algeria, the scene of his first geologic work, where he was stationed from 1920 to 1924 while working for S. Pearson & Sons. He will return to the United States about October 15.

Edmunds Appointed to Head Davison Catalyst Sales

EDMUNDS

Appointment of Page Edmunds as general sales manager of the petroleum catalyst department, Davison Chemical Co. division of W. R. Grace & Co., effective August 1, has been announced by D. N. Hauseman, vice president of Davison's marketing division. Edmunds succeeds Charles W. Saacke, who has resigned to become president of Commonwealth Oil Refining Co., of Puerto Rico.

Edmunds has been with Davison since completing his formal education in 1939. He was successively in the technical service and industrial chemicals departments before joining the petroleum catalyst sales department. He was appointed assistant sales manager of that department in 1948.

Niigata-Worthington, Ltd., Official Visits Home Plant

T. Kurai, president of Niigata-Worthington, Ltd., of Japan, is shown the operation of a large centrifugal refrigeration compressor on test by S. Riley Williams, vice president of Worthington Corp., during Kurai's visit to the parent company's Harrison, N. J., works last week. The Worthington Japanese company, which began operations in November 1953, produces air compressors and pumping equipment needed for revitalizing Japan's refineries, chemical industries, water supply, and merchant marine.

HERE'S EFFICIENT LIQUID COOLING THAT'S A MISER WITH YOUR WATER SUPPLY!

"Buffalo"

EVAPORATIVE WATER COOLERS

- Clean, closed-system cooling for jacket water of diesel, natural gas engines and compressors — also for lubricating or quench oil.
- Designed for economy! Evaporative cooling of spray on compact finned coils means very small water makeup requirements — small fan, pump, power and space requirements — thus, savings in first cost and installation cost.
- Quality "Buffalo" construction means low operating cost. Efficient, quiet-design fans with stable pressure characteristics. Interchangeable, standardized parts, all accessible. Durable "Buffalo" Pumps. Galvanized sheet steel blower section panels. Welded black steel tanks. Aerofin coils.
- Available with automatic controls and recirculating dampers.
- Cooling capacities from 20 to 600 gpm of jacket water.

HERE IS PROVED, DEPENDABLE CONTROL OF LIQUID TEMPERATURE WITH ALL-AROUND SAVINGS, INCLUDING MAKEUP WATER! Write today for Bulletin 3666A for full details.

"Buffalo"

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525 BROADWAY BUFFALO, N. Y.

Publishers of "Fan Engineering" Handbook

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.
Sales Representatives in all Principal Cities

VENTILATING AIR CLEANING AIR TEMPERING INDUCED DRAFT EXHAUSTING
FORCED DRAFT COOLING HEATING PRESSURE BLOWING

As long as you're searching for new oil, why not take a *good* look? Use the industry's most intelligent approach toward establishing a comprehensive record of each foot drilled and cored during an exploratory test . . . Use Core Lab's double-edged derrick-side service of Well Logging (continuous analysis of drill cuttings virtually concurrent with progress of the drill bit) in combination with the finest On-Location Core Analysis available . . . Copies of Core Lab's new 12-page multi-colored Well Logging Folder (containing complete details and typical regional examples of Graphologs and corresponding Coregraphs) are immediately available. Please make request on your company letterhead and direct to address below.

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DALLAS, HOUSTON, CORPUS CHRISTI, MIDLAND, ABILENE, SAN ANTONIO, TYLER, TULSA, FT. WORTH, WICHITA FALLS, OKLAHOMA CITY, ARDMORE, PAMPA, ARKANSAS CITY, GREAT BEND, NEW ORLEANS, SHREVEPORT, HATTIESBURG, JACKSON, LAFAYETTE, DENVER, BAKERSFIELD, WORLAND, STERLING, BILLINGS, CASPER, EL DORADO, LUBBOCK, FARMINGTON, LOVINGTON, CALGARY, EDMONTON, REGINA, CANADA; VENEZUELA, S. A.

EXPLORATION

Geology for the Jean-Agers

by Frank J. Gardner

JUVENILE geologists and junior rock detectives will be sprawled all over the living-room floor of the nation before the year is out, if the kids latch on to the newest gemmological gimmick scheduled to hit the department stores on September 22.

Rock Detective Kit No. 1, produced by the Gemological Institute of America, will go on sale throughout the United States and Canada this month. It is one of five in an educational hobby kit program involving American industrial firms and educational institutions. The other four cover the fields of medicine, meteorology, electronics, and optics.

As "practicing" geologists, youngsters (and adults) can learn the secrets of minerals and rocks with the hobby kit pictured here. It contains a geologist's hammer, a pick, magnifying glass, notebook, gummed labels, two identification charts, strips of copper and glass, a piece of steel, and 24 samples of rocks. Included also is an illustrated book entitled "First Adventures in Geology", prepared under the guidance of Encyclopaedia Britannica. The tests for texture, feel, smell, taste, hardness, and acid reaction are all outlined in simple form, and by the time Junior has finished with the kit and the book, he will have a fairly complete rock collection and be ready to delve deeper into the field of geology.

Early interest essential . . . This new educational program is designed to interest the nation's youth in scientific careers at an early age, and certainly it is a commendable undertaking, of particular importance to the oil industry. For the oil finders of the future must possess a great deal more knowledge, imagination, and training if our pursuit of oil is to continue to succeed. The industry needs to tell its story early in order to capture the imagination and eager attention of the potential geologist and geophysicist.

Recruiting under way . . . To the credit of the two professions, it must be said that considerable progress has already been made along these lines. During recent years, both the American Association of Petroleum Geologists and the Society of Exploration Geophysicists have been at work on programs to reach down into the nation's schools for their future members. The A.A.P.C. has accomplished a great deal of good through its work with the Boy Scouts of America; the Geology Merit Badge and the Boy Scout booths at geological conventions have stimulated interest in geology throughout the country. Recently, with its brochure, "Careers in Exploration Geophysics", the S.E.G. carried the story of geophysics to high-school students everywhere in an effort to recruit the men needed to ease the acute shortage of high-quality technical and professional manpower.

The significant effect of these youth activities on the part of our exploration societies is the nourishment of the spirit of adventure that all small fry possess. Out of adventure comes the urge to discover, the most important quality of the oil finder.

Assets of exploration . . . Exploration men have recognized for some time that the important assets of geology and geophysics are its human assets—human beings with the individual qualities that contribute to successful oil finding. Of these qualities, perhaps the most vital are the spirit of adventure, curiosity, imagination, enthusiasm, and persistence. All youngsters possess them in abundance, and to develop them along the path of oil exploration is a happy responsibility for the A.A.P.G. and the S.E.G.

So if the rockhounds and wrinkle chasers of the future are to perform the job that will be expected of them, their training must begin early. They will certainly face challenges not encountered today, as they are forced to look for less and less oil in fewer places on smaller structures. Scientific training will not be enough in itself, for the demands of tomorrow's oil industry will be more diversified. To meet the challenge and to find the oil, to fulfill the demands and build the industry, and to shoulder the responsibilities of a mechanized world, the human assets must assert themselves to the fullest.

Rock Detective Kit No. 1 is a step in the right direction.

Rock Detective Kit No. 1, designed for juvenile rockhounds.

Seismic crews can now operate during the summer months in the muskeg country of Canada, using tractor-mounted equipment. In the past, exploration efforts were seriously hampered and even curtailed because of the wet, muddy ground.

Muskeg Doesn't Scare These Vehicles

Seismic units march across any terrain, in any temperature

by G. D. Ferrell

EVER since the oil industry first turned its eyes toward the bush country of northern Alberta the big question has been, "How can we work this vast area of 'headaches'"? And "headache" is an appropriate term to describe to the reader the problems confronted in operating seismic crews in country covered by heavy timber growth, deadfall, flat to very steep terrain, muskeg, and last, but not least, temperatures that vary from 95° above zero to 65° below.

Until recently two separate methods were employed to work the northern bush country. In winter, when the ground was solidly frozen, standard truck-mounted equipment was employed; however, just prior to spring breakup the equipment had to be brought out of the bush to the nearest highways and sent to its summer work on the plains. In the bush during the summer months, portable equipment was employed. This method was never considered to be successful because of its high cost per profile. In some instances pack horses were employed with the portable equipment, but production was still low. In addition to the low production, the portable drills could never provide holes deep enough for accurate near-surface velocity information, to properly correct for weathering.

Author is field supervisor, Century Geophysical Corp. of Canada.

The industry is at present attempting to develop a vehicle that can be utilized effectively all year 'round. It should be pointed out here, however, that regardless of when the bush country is worked, summer or winter, all trails must be cut during the winter months when the ground and muskeg are frozen solid enough to support bulldozers.

Muskeg tractor . . . As an answer to the pressing need for such equipment capable of operating the year 'round in the northern portions of western Canada, muskeg tractors are being utilized.

The Bombardier muskeg tractor, so called because of its ability to propel itself through muskeg, probably is not the final answer. The tractor unit is manufactured in Quebec with a western distributor located in Edmonton, and is adaptable to mounting most any kind of seismic equipment required; provided, of course, that weight, a prime factor in muskeg operations, is kept to a working minimum. The muskeg tractors operating in the field today are equipped with standard seismic instruments and several types of air and/or water rotary drills.

It is believed that this machine is the only industrial powered vehicle available to the general public in which the differential is in the front rather than in the rear.

Steering is accomplished by means of two hand-operated brake levers in the front of the tractor giving brake action to hold one track while the other track continues to pull. This is a very similar process to that of clutch steering employed in heavy-duty-type crawler tractors. The turning radius of the vehicle is 15 ft. on a slippery surface but tends to become larger as the ground becomes drier. Maximum speed quoted is 25 m.p.h.; however, it appears that the optimum practical speed ranges between 6 and 8 m.p.h.

To fill a need where a powered unit is not required, a tractor trailer is provided with three single tires per side running on an 18-in. cleated track. These trailers are about 5 ft. wide and 9 ft. long and can be used for water tanks, dynamite magazines, and instrument mountings.

For survey units, a conventional Tractor Track is available. A belted, cleated track, idler wheels, and axle come as a complete unit readily adaptable to a Ford, Ferguson, Case, or similar type farm tractor.

Because of extreme weather conditions and to facilitate operations it is necessary to mount cabs on the basic unit to house personnel and instruments. The cabs can be designed to fit any specification and can readily be made up by a local fabricator.

It is highly recommended that the cabs be insulated and equipped with a

heavy-duty water heater to provide protection from the severe weather during the winter months. During the summer some method of cooling the cab should be devised as the cab heat becomes intense during hot days. Special air filters are required to protect motor from dust.

Winches can be mounted on the tractor units with comparative ease, but in most cases it will necessitate cutting a hole in the toboggan to accommodate the power takeoff.

Driving the muskeg tractor is a fairly easy operation, yet it takes the operator several days to get used to its slow crawling pace.

This equipment is definitely "special" and preventive maintenance is imperative. Actual repairs on the equipment are not difficult to make, and the supplier is most cooperative in training the operator's mechanics in the supplier's plant.

The tractor performs wonderfully well in going through all kinds of mud, muskeg, dry ground, and shallow pools of water. No lake or deeper body of water has been tried to test its full flotation power, but it is believed the machine will float.

This machine should operate in the steep foothills country as well as in the muskeg areas because it has all the traction needed to climb very steep hills.

As in every type of equipment there are problems that must be overcome by trial-and-error methods. Some are problems that must be worked out because of the terrain, or perhaps because of the weather. Perhaps the main problem is solved by winterizing the unit, but another difficulty arises if the battery fails to turn over the motor. These vehicles are very hard to pull and because of the waterproof toboggan a torch can't be used easily to heat the motor. There are, however, several types of heaters that can be used to keep the unit warm. A good battery and proper weight oil are needed at all times.

Water is the lubricating agent for rubber parts during wet seasons. In summer, however, lack of water on the ground creates a serious problem. Excessive wear and tear is experienced on the sprockets and belts, and no satisfactory solution to this has been found. During the spring and fall, the tractors are easy to start and sufficient lubricating water is available to lubricate the rubber parts. During these periods the sticks or stumps floating in the water or buried in the mud drive into the tracks ripping off cleats or puncturing tires.

If a tractor tire has been run flat for more than a few minutes, the tire, tube, and wheel are all ruined. This is one of the most unfavorable features of the machine. To date the operators have been unable to obtain a solid rubber tire to replace the pneumatic tire. The most serious problem encountered is trying to keep the drive sprockets from tearing. There is an improved sprocket in production, and it is hoped this will minimize the sprocket troubles.

Despite the problems of high maintenance and operations, the muskeg tractors are adequate and well worth the investment to accomplish the difficult task of carrying out successful seismic exploration in the northern portion of western Canada on a year 'round basis. The cost of a complete seismic crew

North King unit . . . There is another unit on the market called the North King Universal Transporter. This unit has been tested in seismic fields and the industry looks at it with favor. The machine is nearly twice as long and twice as heavy as the Bombardier, and the fabricators claim it will carry twice the load. It is a two-section unit with power unit in the front section and load carrier in the second section, tied together by a swiveled gosseneck arm. The unit can be used in the plains areas without tracks. It can operate in very rough terrain and over the muskeg with or without tracks.

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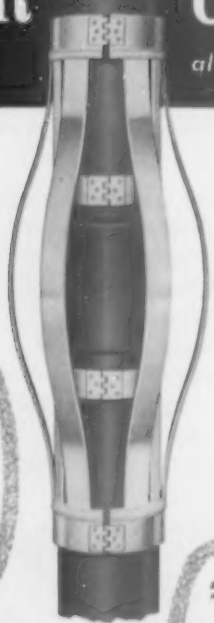

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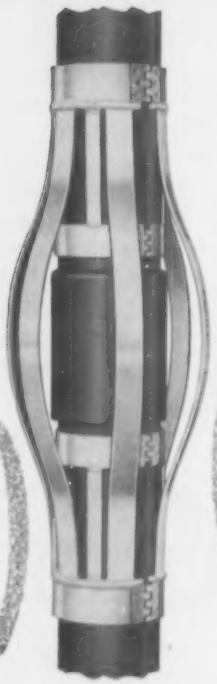
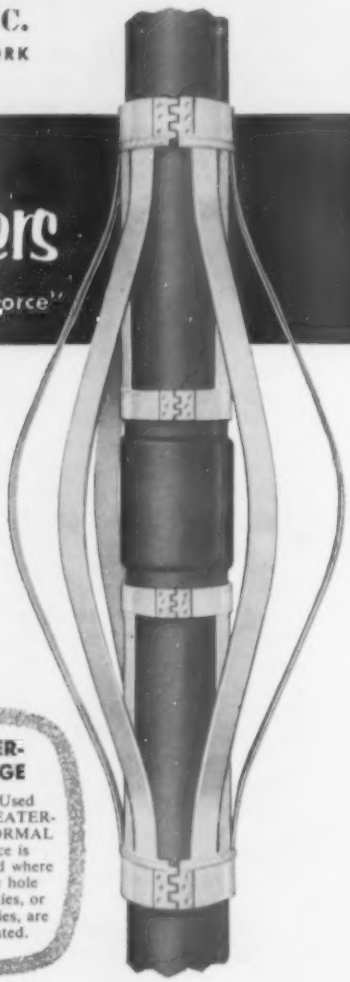


25-RANGE
Used where NORMAL clearance is present, and no serious problem of over-size hole is anticipated.



SUPER-RANGE
"H-50" Used where GREATER-THAN-NORMAL clearance is present and where extensive hole irregularities, or even cavities, are anticipated.

mounted on Bombardier muskeg tractor with necessary equipment excluding recording instruments would amount to about $60,000, whereas a similar crew equipped with North King Tractor would approximate $85,000.

Acknowledgment

The writer would like to express his appreciation to P. I. Bediz and J. R. Williams of Century Geophysical Corp. of Canada for help in the preparation of the manuscript.

CALIFORNIA

Glenn County Gas Discovery Reported

Richard S. Rheem, as operator, has made a gas discovery in Glenn County about 2 miles northwest of Beehive Bend gas field. The 1-63 Zumwalt in 2-19n-2w flowed on a test at the rate of 4.5 to 7 million cu. ft. per day, mostly through ¾-in. choke. With tester 2,000 ft. from the top of the hole, the well flowed partially out of control for about 2 hours until the flow was killed with mud. Total depth is 6,185 ft. with 5½-in. casing cemented at 6,156 ft. Producing sand has not been identified.

New Pool Discovery in Belgian Anticline Field

Ohio Oil Co.'s recent Belgian Anticline completion, originally considered a northwest extension of Oceanic production in this field, has now been identified as a new pool discovery and has turned out to be one of the best wells completed in this area. The 1 F. E. Smith in 23-30s-21e, which tested for an estimated 200 bbl. a day of 31.9°-gravity crude, has been completed for 1,274 bbl. of 32°-gravity crude, 0.5 per cent cut, and 644 M.c.f. of gas through a 20/64-in. choke. Well is about 3,000 ft. northwest of production.

Deep Production Extended In Oxnard Field

Standard of California has extended deep production in Oxnard field, Ventura County, about 2,000 ft. to the south, based on successful tests of its 301 Lennox in 6-1n-21w. Drilled to 10,522 ft. and plugged back to 7,070 ft., the interval 6,785-7,008 ft. was tested for 300 bbl. a day of 28.5°-gravity oil, 12 per cent cut. Well has since been completed and is making 310 bbl. of 28°-gravity oil and 200 M.c.f. of gas through a 14/64-in. choke. Nearest deep producer is Standard's 1 McGinnis to the northwest which is producing from the Sespe at 6,280-6,374 ft. Probability is that the Lennox well is a new pool discovery.

Rincon Extension Indicated

General Petroleum Corp. has an indicated extender of deep zone production in Rincon field in Ventura County. Operator is preparing to complete the 101 Ferguson, an offshore test located ½-mile west of present production. Total depth is 7,303 ft., with 5½-in. casing landed at 7,301 ft.

APPALACHIAN AREA

WEST VIRGINIA

In Moorefield district, Hardy County, West Virginia, Baker & Hershberger 1 Thomas Williams, rank wildcat, elevation 949 ft., completed as a dry hole in the Medina sand, Oriskany sand 594 ft., Clinton sand 3,315-3,807 ft., TD 3,962 ft.

OHIO

Pure Oil Co. moved to the west side of an old productive lease and brought in a nice well, the 7 S. M. Gutridge, Section 18, Hopewell Township, Licking County. Clinton sand at 3,048-3,094 ft. filled 800 ft. natural and produced 214 bbl. in a 24-hour test after fracturing. Two miles to the northeast, at the edge of the pool, Oil Development 1 Flowers and Lucas Consolidation, Section 11, gaged 200,000 cu. ft. natural and 900,000 cu. ft. after fracturing. Clinton was logged at 3,179-3,215 ft.

At the east end of the town of New Castle in New Castle Township, Coshocton County, Frank Lyons et al 1 John Sells made 10 bbl. natural and 150 bbl. in 24 hours after fracturing from second Clinton at 3,303-3,317 ft.

PENNSYLVANIA

Monroe Township, Bedford County, Southwest Pennsylvania, John Galey 1 Donald Miller, elevation 1,000 ft., which topped the Oriskany sand at 4,880 ft., encountered gas at 5,114 ft., testing 57,000 cu. ft., now tests 38,000 cu. ft., and is drilling at 5,134 ft. Pine Township, Indiana County, Fryer & Hansen 1 Lucinda Mitchell, elevation 1,670 ft., reached the Oriskany sand at 8,169 ft., and is running a drill-stem test at 8,179 ft. Parker Township, Butler County, Walker et al 1

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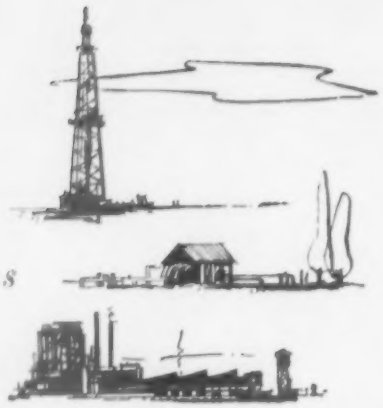

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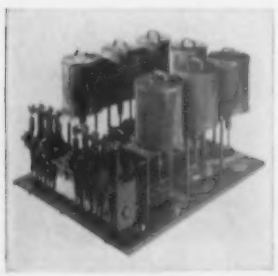

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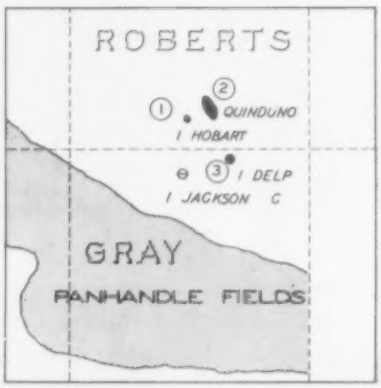
John Walker, is at 5,380 ft. Connellsville Township, Fayette County, Peoples Natural Gas Co. 4030 F. K. Buttermore heirs, is drilling at 8,759 ft., and in Salt Lick Township, Mid-Atlantic Oil & Gas Co. 1 Adolph Dupre, at 6,415 ft.

HUGOTON EMBAYMENT

Deep Anadarko Basin Discovery Completed

Phillips Petroleum Co. has completed its 1 Delp in Gray County, Texas Panhandle, as a deep Pennsylvanian granite wash discovery.

The 1 Delp in Section 110, Block M-2, BS&F Survey, flowed 257 bbl. of oil daily through ¼-in. choke from granite wash perforations at 9,558-65 ft. (3 on map). Gas oil ratio is 800:1. Gravity is 43.6°.



This is the third deep discovery in the general area of the Anadarko basin of Gray County. The Phillips 1 Hobart (1 on map) is a Pennsylvanian granite wash producer. In Quinduno field, 12 miles to the northwest in Roberts County, the Gulf 1 Haggard is a Pennsylvanian granite wash producer in the lower Albany dolomite field (2 on map).

Gray County and Phillips have a second deep test that is promising production at 1 Mrs. M. Jackson "C." This wildcat is 6 miles west of the 1 Delp.

Meade Area In Kansas Records Atoka Discovery

An Atoka discovery 9 miles southeast of Kismet, Kansas, has been potentialed for 198 bbl. of oil daily.

It is Ohio Oil Co. 1 Bond, NW NW SE 32-33s-30w, 2 miles south of East Kismet field in Meade County. The discovery was completed with production from perforations at 5,619-31 ft. Production came after acidization.

Greenwood Confirmation Awaits Its Potential

The southeast offset and confirmation to Greenwood field's only oil well is awaiting potential.

It is J. M. Huber Corp. 2 U.S.A. "C," SE SW 29-34s-43w, Morton County. The discovery flowed 18 bbl. of oil per hour from 4,193-97 ft. in the Morrow. It is located 2 miles east of Colorado's state line and 4½ miles north of Oklahoma. Stanolind Oil & Gas Co. 1 U.S.A. "C" is the oil discovery in Greenwood field. It produces 252 bbl. per day

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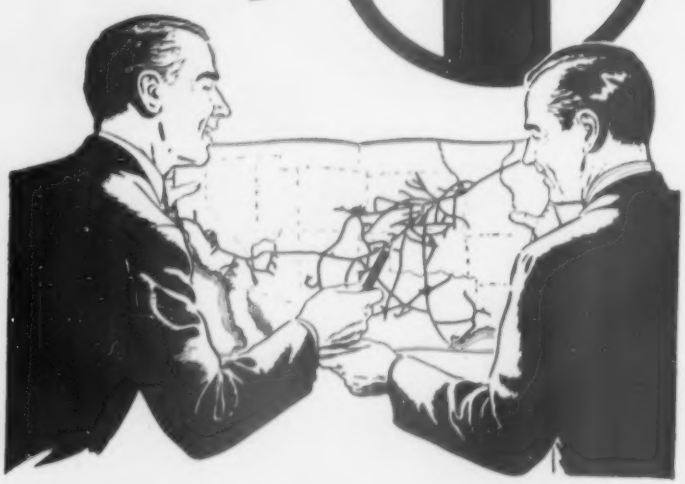

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on the pump. Nearest production of the type is about 8 miles to the south in Keyes field, Cimarron County, Oklahoma Panhandle.

Northwest Eva Cherokee Extension Completed

The fourth Cherokee (Pennsylvanian) oil discovery in Northwest Eva field's south extension area has been completed by Baker & Taylor Drilling Co. at 1 Williams, NW NE 14-4n-10eCM, Texas County, Oklahoma Panhandle.

The well was potentialed for about 100 bbl. of oil per day with some water. Perforations were at 4,028-31 ft.

OKLAHOMA

Deese Discovery Flows at Good Hourly Rate in Grady

E. J. McCurdy, Jr., and E. R. Bahan 1 Bowen, new Grady County Deese sand discovery well in C SW SW 18-5n-6w, 1½ miles northeast of West Chitwood pool, flowed 23 bbl. of new oil per hour on ½-in. choke after fracturing.

The discovery later increased its flow to 35 bbl. of oil per hour for 24 hours on ¾-in. choke. The discovery is shut-in for tanks and connection to pipeline.

North Sweet Home Pool Extended Southeast

Davidor & Davidor have extended North Sweet Home pool in Lincoln County ½ mile to the southeast with the completion of 1 Miller, NW NW NE 27-15n-3e.

The extension well flowed 96 bbl. of oil per day through ½-in. choke from Cleveland sand perforations at 3,372-78 ft. Lee Evans 1 Turner, SE NE SW 23-15n-3e, an old well to be worked over, will test the Cleveland sand. The Texas Co. is finishing up at 2 Wakley, SE SW NE 21, in the pool itself. It flowed 116 bbl. of oil through ¼-in. choke natural on a 24-hour test.

Davidor & Davidor 2 Delphon, SE SW NW 22, flowed 35 bbl. of oil following fracture treatment on a ⅛-in. choke. The 1 Delphon in NW SW NW 22 was finaled for a gage of 373 bbl. of oil in 24 hours through 15/64-in. choke.

New Grant Pool Seen

A successful drill-stem test was reported at a new possible Grant County discovery, Cities Service Oil Co. 1 Wald, SW SW NE 22-25n-5w.

The test was taken in the Mississippian at 5,366-5,455 ft. Recovery was 270 ft. of oil and gas-cut mud.

The indicated prospective hit is 6 miles southeast of Grant's Pond Creek town and 3 miles southeast of East Pond Creek pool.

New Pay at Creek's West Tuskegee Pool

Creek County's West Tuskegee pool has a ½-mile plus west extension and new-pay discovery at Murta & Son and Acorn Drilling Co. 1 Moore, SE NE NE 34-14n-9e.

The new pay in the extension well is the Union Valley lime. The zone discovery well flowed about 100 bbl. of oil per hour after perforating. Then on 1-in. choke it flowed

at the rate of 80 bbl. per hour. The natural flow is from perforations at 3,036-42 ft. Production at West Tuskegee is from the Dutcher.

South offset work is showing success in the area. Mercury Drilling Co. is preparing to test at the 1 Moore, NE SE NE 34 with the Union Valley logged at 3,026 ft. Recovery on a drill-stem test at 3,024-36 ft. was 215 ft. of slightly gas-cut mud. Mud was recovered on a test at 3,036-45 and on one at 3,028-3,105 ft.

NEW MEXICO

SOUTHEAST NEW MEXICO

Lea County Wildcat Reports Distillate Show

G. E. Hall 1-A State, 16-15s-36e, 4 miles northeast of Lovington, developed gas-cut mud in the Devonian from 13,413-13,466 ft. A 2-hour test from 13,465-13,505 ft. recovered 7,000 ft. of gas in the pipe, 2,300 ft. of distillate, and 2,600 ft. of water blanket cut with gas and distillate. Twenty-minute shut-in pressure read 5,515 psi. Sample top on the Devonian was 13,413 ft.

Buffalo Oil Co. 25-A Baish, originally a Strawn discovery in the Maljamar field, Lea County, has been plugged back for recompletion in the Abo, a new pay zone for the field.

Daily potential was 177 bbl. of 42° oil, from perforations between 9,866-10,840 ft. Choke size, if any, was not reported. Mud and regular acid treatments were used on the pay section. Original total depth was 12,778 ft. and first completion was for 814 bbl. of oil a day from pay at 11,616 ft.

CANADA

Initial Potential Reported At Big Manitoba Strike

An initial potential of 2,160 bbl. of 34°-gravity oil has been established at the Sooner Petroleums, Ltd., wildcat in the Cromer area of southwestern Manitoba. This well, 3¼ miles southeast of Mississippian oil wells in Daly field, is rated as either a Mississippian oil discovery or an extension to Daly field. Further drilling between the field and the new producer will determine the discovery or extension status of this venture.

The new oil producer, situated 15 miles southwest of the town of Virden and the Roselea oil wells and 55 miles west-southwest of Brandon, is Sooner 8-15 Hayhurst. Hole was taken down to total depth of 2,560 ft. and 5½-in. production casing was landed at 2,533 ft., leaving 27 ft. of open hole. K. B. elevation at the well is 1,616.64 ft. The flow test rating the 2,160-bbl. per day initial potential was run without treatment to the Mississippian producing formation.

Wimborne . . . After drill-stem testing 31 ft. of water-free D3 Devonian coral reef at the Wimborne oil discovery well in southern Alberta, a third drill-stem test 10 ft. lower yielded an oil flow, but when pipe was pulled it was found to contain formation water in addition to 38°-gravity crude oil.

The discovery well, Seaboard-Banff 7-9 Wimborne, LSD 7, 9-34-26w4, ran its most recent drill-stem test from 7,467 to 7,481 ft. for 1½ hours. There was a good initial puff, with water cushion being forced to surface in 63 minutes. Gas flowed in 80 minutes at 700,000 cu. ft. daily and oil flowed in 85 minutes. When pipe was pulled it was found to contain 1,240 ft. of oil and 450 ft. of sulfurous oil-cut salt water.

The drill-stem test above that last interval was run from 7,450-71 ft. for 40 minutes. Gas flowed in 18 minutes and oil in 25 minutes. Gas flow rate was between 4,000,000 and 5,000,000 cu. ft. daily and recovery was 550 ft. of clean oil and 90 ft. of mud. The discovery test, from 7,435-60 ft. flowed gas in 15 minutes and gas plus distillate in 27 minutes, with gas rate estimated at 6,000,000 cu. ft. daily.

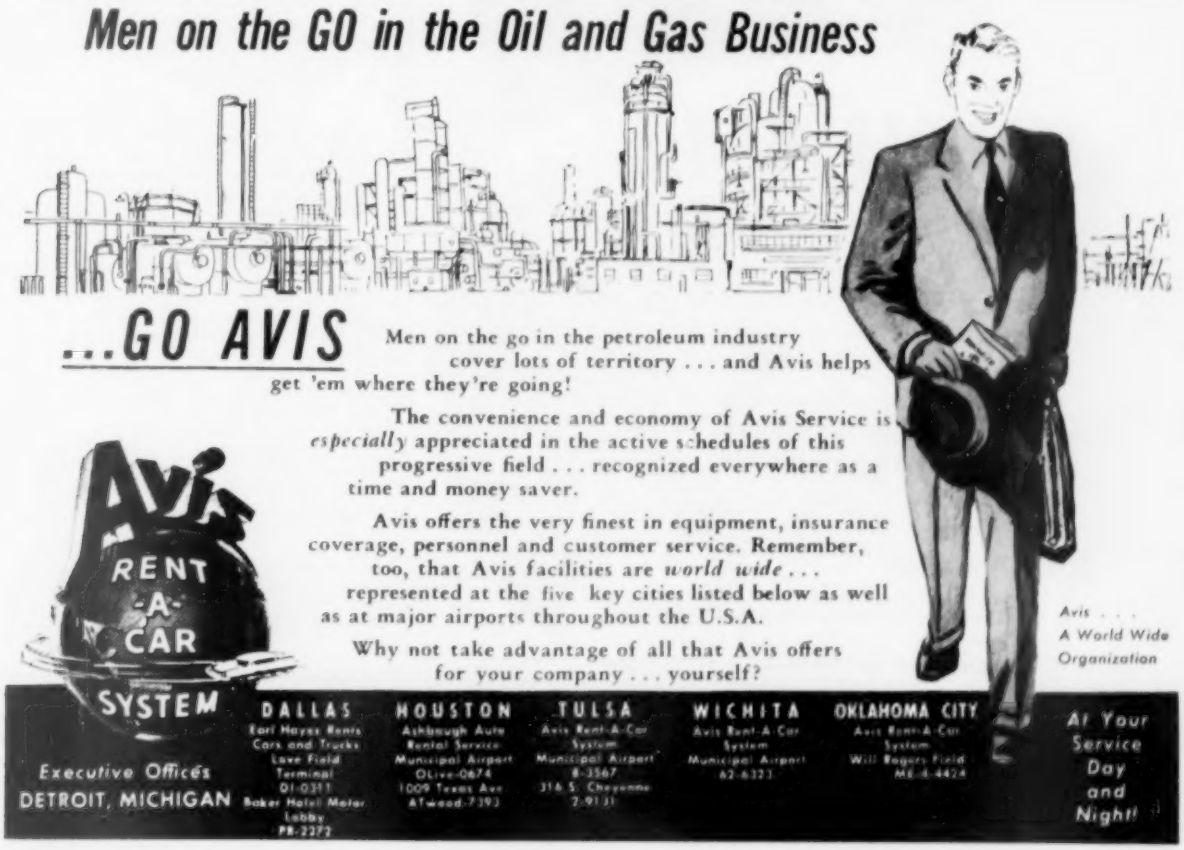
Top of the reef was at 7,440 ft., or 4,270 ft. below sea level, and backers of the project are assured of at least 31 ft. of water-free reef with probably at least 5 to 8 ft. that also has oil but may have some formation water present. At weekend crew was awaiting orders with bottom hole at 7,481 ft.

The well is 15 miles southeast of Innisfail, 20 miles northeast of Olds and 60 miles north-northeast of Calgary.

Hillsdown . . . The Hillsdown wildcat in central Alberta, about 5 miles east of Red Deer and 13 miles south of Lacombe, has struck some crude oil in D3 Devonian reef, backers of the well announced today. This well had, 1 week ago, given up some oil in the D2 Devonian zone.

This wildcat, Seaboard-Canadian Superior 14-17 Hillsdown, is 3¾ miles south-southeast of the Imperial 5-5 Red Deer well that discovered Viking oil and 4¾ miles west of Joffre area Viking oil wells.

Hillsdown No. 14-17 entered D3 reef at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7,336 ft., or 4,049 ft. subsea (K.B. elevation 3,287 ft.) and first reef drill-stem test was run from 7,322 to 7,346 ft. for 100 minutes. Natural gas reached the surface in 80 minutes, at rate 50,000 cu. ft. daily, and pipe recovery consisted of 1,340 ft. of water cushion, 320 ft. of oil and 260 ft. of gassy oil-cut mud.

The report stated that the second test was run in the interval 7,335 to 7,356 ft. for 110 minutes. Gas flowed to the surface at rate of 125,000 cu. ft. daily and recovery was 1,330 ft. of water cushion, 180 ft. of oil and 1,080 ft. of slightly oil-cut sulfurous salt water. Crew was drilling at 7,375 ft. at latest report.

The D2 Devonian contact was at 7,160 ft., or 3,773 ft. below sea level, and drill-stem test from 7,183 to 7,213 ft. for 110 minutes flowed gas in 70 minutes, at rate 150,000 cu. ft. daily. A 1,240-ft. water cushion was used, and other fluid recovery was 200 ft. of oil and 40 ft. of oil-cut mud.

KANSAS

Cherokee Discovery Given Pawnee County

Northwestern Pawnee County has a new Cherokee oil discovery at National Cooperative Refinery Association 1 Ekert, NW NW NW 18-20s-19w, 1 mile east of Shiley pool.

Recovery on a drill-stem test at 4,211-32 ft. was 2,640 ft. of free oil.

Southeast Pawnee . . . Atlantic Refining Co. 1 Smith, NW NW SW 3-23s-15w, 1½ miles southeast of Southwest Dunes pool, is going on pump after swabbing netted 6 bbl. of oil hourly for 5 hours through Simpson perforations at 4,023-37 ft.

Mingo Pool Reopened In Thomas County

Thomas County's abandoned Mingo pool has been reopened at 1 Keller "A," NE SW SW 19-9s-32w, by Phillips Petroleum Co. et al.

A swab test got 10½ bbl. of oil per hour from Marmaton-Cherokee perforations at 4,484-4,532 ft The test is going on pump.

Drilling Block Announced

Falcon Seaboard Drilling Co. of Tulsa has announced the acquisition of a 7-well drilling block tract totalling 42,000 acres in central and eastern Kiowa County, Kansas.

First hole will be located in Township 29-16w, southwest of Greensburg, and additional tests are slated for 28-16w, 28-17w, 30-17w, 28-19w, 29-18w, and 27-16w.

Kiowa County has been surrounded by drilling, but has been overlooked previously in the extensive wildcatting along the central Kansas uplift.

A recent good showing in a wildcat in the extreme northern part of Kiowa, and shows in a wildcat in the extreme northwestern part of Kiowa have increased interest in Kiowa, and another wildcat will soon be under way in southern Edwards County, north of Kiowa.

ILLINOIS

Illinois ranks first among the oil-producing states east of the Mississippi River and continued during August to produce oil at the rate of about 2 bbl. a second. Total production in August was 5,613,000 barrels.

Oil operators discovered one new pool and

extended productive acreage in three pools during August. Two new pays were discovered in one pool.

The new oil pool is Dubois Central in the town of Dubois in Washington County. It was discovered by a wildcat well drilled 2 miles from production in Dubois pool.

Oil pools extended by successful wildcat wells were Mt. Auburn Consolidated (Christian County), Main (Crawford County), and Norris City (White County).

The two new pays are the Bethel and Aux Vases sandstones, both in Ellery North pool, Edwards County. This small pool, which formerly produced from the Ste. Genevieve, had been abandoned.

Wells completed in the first 8 months of 1954 totaled 2,007, almost equal the total of 2,161 completed in 1953. Operators completed 257 wells during the 4 weeks covered by this report, or an average of about 67 wells a week.

Of the 257 wells drilled, 141 were producing wells and 63 were dry holes completed in pool areas. One of the 18 wildcat wells drilled more than 2 miles from production discovered a new pool. Four wildcat wells drilled within 2 miles of production extended productive acreage in three pools. Drillers worked over a number of former dry holes and made 10 of them into producers.

TEXAS

NORTH TEXAS

Wise and Montague Counties List Strikes, Prospects

Week's developments in North Texas fields included a Pennsylvanian discovery completed in Wise County, two prospective conglomerate strikes in Montague and a new-pay well for Shackelford County.

In Wise County, Sherrod & Apperson 1 Amanda Lowrie, 4 miles northwest of Chico, flowed 98.44 bbl. of 44° oil a day through 23/64-in. choke, with gas-oil ratio of 700 cu. ft. and tubing pressure at 80 psi. Pay was the Atoka conglomerate between 5,552-5,610 ft., which was perforated between 5,552-73 ft.

Encouraging tests in conglomerate sections were made on two separate Montague County wildcats. Star Oil Co. 1 Johnson, 5 miles northeast of Bowie, recovered 1,650 ft. of clean oil on a 1-hour test from 6,424-47 ft. Location is approximately 2 miles south of Hildreth field.

Arnold H. Bruner and Northex Oil & Gas Co. 1 McCall-Fooshee, 3½ miles northwest of Montague, flowed an estimated 50 bbl. of oil an hour on a test from 6,288-96 ft. Oil reached the top in 18 minutes, and was shut in to run electrical surveys. Drilling continued below 6,510 ft. at last report.

Grayson County . . . Standard Oil Co. of Texas 2 Stout, J. Hutson Survey, has added Oil Creek production to the Sherman 7,500-ft. Strawn pool, 2 miles northwest of Sherman. On ground elevation of 800 ft., the well went into Oil Creek sand at 10,452 ft. and a drill-stem test in the top of the sand produced 11 bbl. of oil in 30 minutes through ¼-in. choke. On potential test, from perforations at 10,456-74 ft., "Y" zone, and from 10,504-16 ft., in the "L" zone, the well made 26,000,000 cu. ft. of gas and 350 bbl. of distillate. Choke size was 19/64-in.

Humble Oil & Refining Co. 1 Davis, wildcat 4 miles southwest of Sherman, ran electrical surveys to 10,284 ft., then ran casing to 10,315 ft.

Grayson County was in line for two addi-

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tional deep tests. R. W. Mott et al 3 Carraway was staked in the Sherman field in the McAnair Survey. The other is to be a townsite location by Allen Guiberson and I. M. J. Turner. Location is also in the McAnair Survey, A-763, and northwest of the Sherman courthouse. Projected depths were 11,000 ft. on 3 Carraway and 9,000 ft. for 1 Turner.

TEXAS GULF COAST

Extension Well Discovers New Oil Pay in Arch Area

Production in the Arch area, northwestern Matagorda County, has been extended about ¾ mile northwest with a new-pay discovery by Kilroy Co. of Texas.

The new well, 1 White, drilled to 8,600 ft. but completed in a middle Frio sand, perforated at 7,685-88 ft., flowed at the rate of 260 bbl. of 32°-gravity oil daily during a 12-hour gage through 9/64-in. choke. Pressure was 875 psi.

The pay is approximately 250 ft. deeper than deepest known productive zone in the Arch area. The field, discovered in August 1948, has three pay zones, all in the Frio. Six productive wells have been completed, although only three currently are on production.

Two New Tests Follow Lou Hill Oil Discovery

Two additional tests are getting under way in the new Lou Hill area, 6½ miles southeast of Louise, in western Wharton County.

Caribbean Oil Corp., which opened the area for production earlier this month, has moved 2,700 ft. east of its discovery well for its second test, 1 Hancher, in Section 30, T. W. Heard Survey.

Holmes Drilling Co. and San Juan Exploration Co. are joint operators in a projected 7,200-ft. test at 1 Kountze & Stewart, in Section 29, Morris & Cummins Survey, about 1 mile southeast of the discovery well.

The discovery well, 1 Stovall, was completed in sand at 5,454-56 ft., making 92.5 bbl. of 27.8°-gravity oil per day through 8/64-in. choke with pressure of 480 to 500 psi.

The new area is about 1 mile east of the south tip of Louise field, nearest other production.

WEST TEXAS

Headlee-Ellenburger Field Extension is Completed

British-American Oil Producing Co. 1 Roy Parks, Jr., 1-mile south extension to Headlee field, in Section 28, Block 41, Township 2 South, T&P Survey, has been finished for a flowing potential of 739 bbl. daily. The new well has moved field limits southeast into Midland County. Production was through 14/64-in. choke from two sections of perforations in the Ellenburger. These were between 12,128-82 and 13,044-13,108 ft. Total depth was 13,350 ft. Flowing pressure was 1,825 psi. and gas-oil ratio was 1,189 cu. ft. Gravity of the oil was 52°.

Forest and Cities Service 1-B Dora Roberts, 3½ miles to the southeast of British-American's extender, was drilling ahead at 12,039 ft. This well developed oil and gas-cut mud on a drill-stem test in the Devonian between 11,295-11,464 ft. Its sample top on the Strawn was 9,760 ft., minus 6,907 ft., compared with 9,880 ft. and minus 7,007 ft. on the same formation in 1 Roy Parks, Jr.

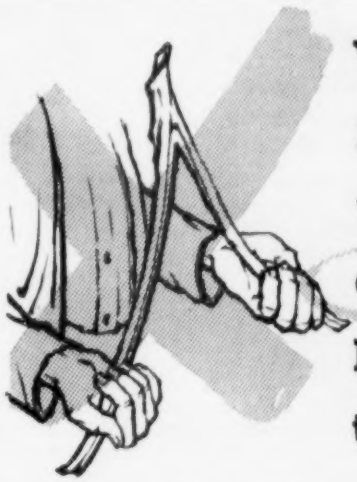
Terry Strike Completed

Anderson-Prichard Oil Corp. et al, 1 Oil Development Co., 2 miles northwest of Wellman, has been completed for a calculated potential of 940 bbl. a day, from Devonian, or Siluro-Devonian pay, as tentatively identified.

The high flowing potential, with nearly zero gas-oil ratio, was based on an actual gage of 509.6 bbl. of oil in 13 hours through 48/64-in. choke. Top of the Devonian was placed at 12,750 ft. on elevation of 3,326 ft., and casing perforations were made between 12,763-12,778 ft. Completion was without acid treatment.

Coke County . . . C. L. McMahon, Inc., 1-A Hendry, 1-mile northeast offset to the firm's recent Gardner sand discovery, has developed considerable oil on a drill-stem test in Cambrian sand. Top of the Cambrian was reported at 5,722 ft. on elevation of 2,014 ft. A 3-hour test between 5,715-27 ft. had gas in 18 minutes, no estimate on volume, and recovered 1,310 ft. of clean oil plus 90 ft. of oil-cut mud. The operator's first test swabbed 100 bbl. of oil and 92 bbl. of water in 12 hours from perforations in Cambrian sand between 5,710-20 ft. before plugging back to complete in the Gardner. No. 1-A Hendry checked 8 ft. low to the discovery on the sand.

Winkler County . . . Barnes-Lyman 1 Kerr, Ellenburger wildcat 5 miles south of Kermit in the shallow Weiner area, reported shows of oil in the Ellenburger. Top of the formation was tentatively picked at 11,430 ft. on elevation of 2,827 ft. On a test from 11,502-11,555 ft., open 68 minutes and using 1,000 ft. of water cushion, gas showed in 8½ minutes.



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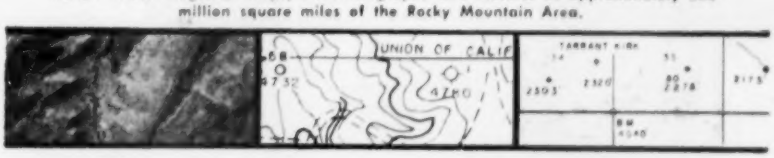

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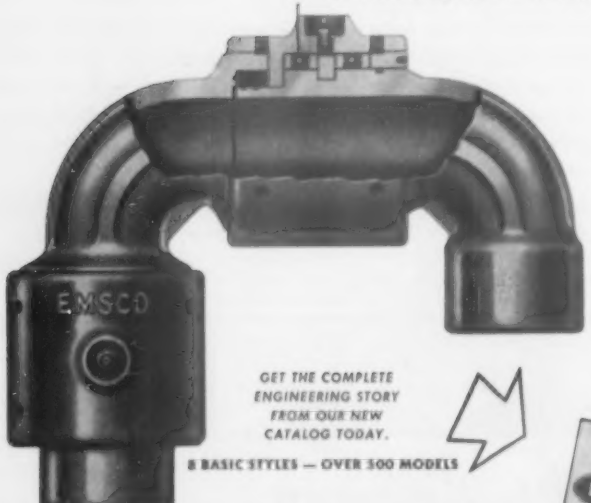

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and recovery was gas-cut and slightly oil-cut water blanket, plus 100 ft. of free oil. Operators were drilling ahead in dolomite.

SOUTHWEST TEXAS

New Oil Pool Opened in Mathis Area Discovery

H. H. Howell and William H. Winn, of San Antonio, are completing a new oil-discovery well in the Mathis area, northwestern San Patricio County.

The well, 2 Luther et al, was drilled to 4,238 ft., and is perforated at 4,217-20 ft. in sand, in which a 20-minute open-hole drill-stem test through ¼-in. chokes recovered 960 ft. of clean oil and 420 ft. of oil-cut mud, plus 400 ft. of water. The test recorded initial bottom-hole pressure of 1,350 psi., 1,475 psi. final, and 1,725 psi. shut in.

Location is 3 miles northwest of Mathis in Mathis Land & Town Subdivision 12. It is 1,000 ft. southwest of the operators' initial test, 1 Luther, abandoned at 4,783 ft.

LOUISIANA

NORTH LOUISIANA

Rodney Island Outpost Taking Potential Test

Potential is being run at McCormick-Short-Randolph-Jett Drilling Co., Inc. 1 Harper, 12-10n-12e, 1-mile north outpost to Rodney Island field in Tensas Parish, eastern Louisiana.

The well is producing from perforations at 9,250-55 ft. in the lower part of 29 ft. of net Massive sand through ⅛-in. choke.

Liberty Hill Gas Well Confirmed By Placid

Placid Oil Co. has confirmed the discovery well of Liberty Hill field in eastern Bienville Parish.

The 1 Southern Advance Bag & Paper Co. et al A-2 Unit, C SW NE 7-15n-5w, west offset to the discovery well, is shut in for potential. The discovery well of the field was 1 Southern Advance Unit A-1, SE NW 8-15n-5w. It flowed 6,000 M.c.f. of gas per day through ⅛-in. choke.

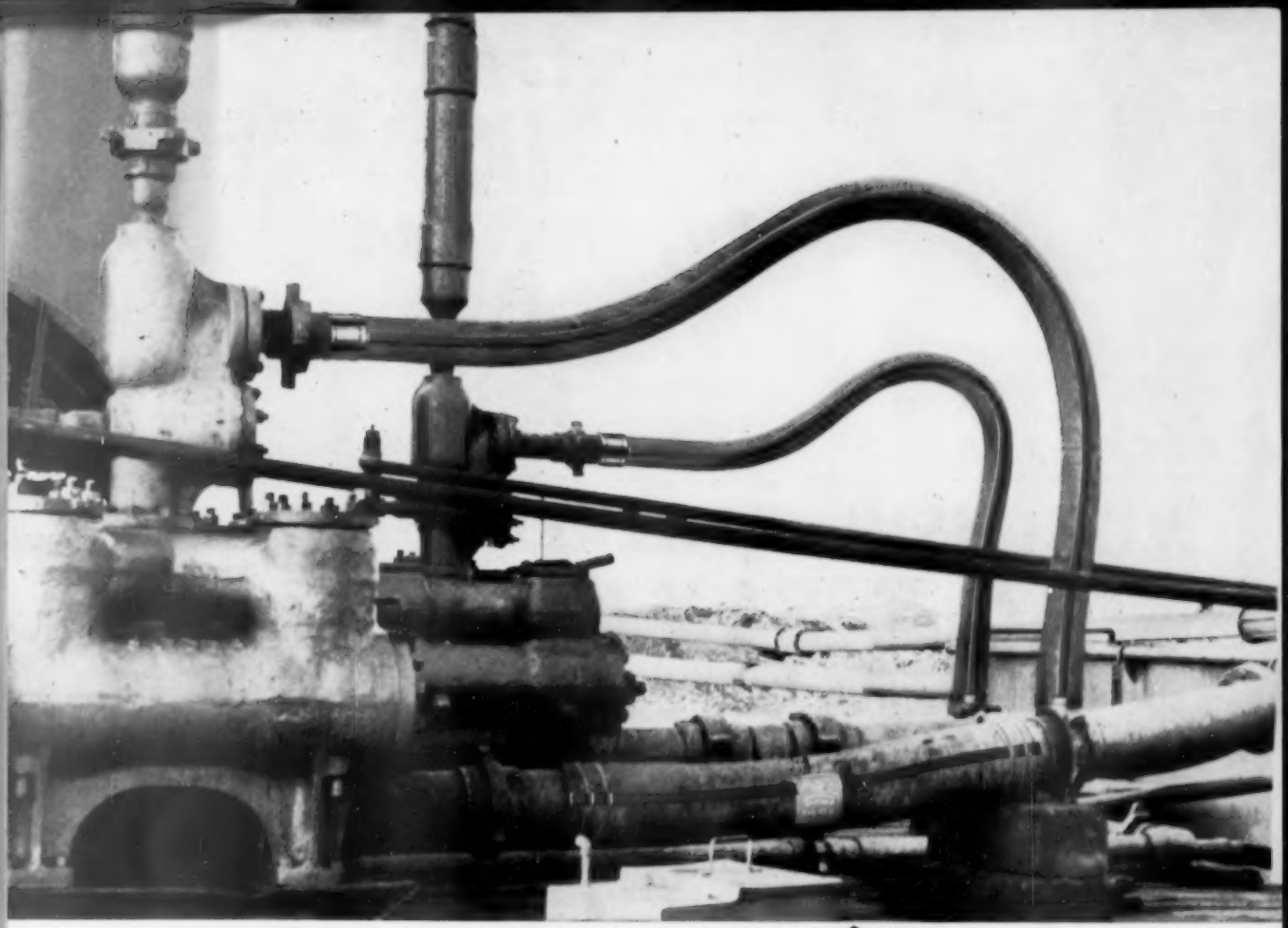
August Strikes

Pine Grove field was opened in Ouachita Parish during August with production from the Pettit and Travis Peak formations.

Carter Oil Co. 1 J. H. Rhymes heirs, 26-17n-4e, about 4¼ miles southeast of Monroe and 2 miles west of Millhaven field, flowed 5,250 M.c.f. of gas per day from the Pettit and 4,500 M.c.f. from the Travis Peak.

Three Wilcox Pools Opened In August

Northern Louisiana got three new Wilcox pools in August. Durbin Bond & Co. and Petersen Drilling Co. and Union Producing Co. finaled 1 Turner, opening Milestone Forks field in Concordia Parish. W. L. Billups, Gauthier & Heard completed 1 Miller et al to open Wilcox oil production in the old Clayton gas field of Concordia. It is in 40-8n-10e. The well flowed 138 bbl. of oil per day through 9/64-in. choke from the Wilcox.



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The field now has two oil wells, one in completion stages, and locations have been staked for two more wells.

R. T. Jameson and Associates 1 Urania, 5-10n-1e, Winn Parish, opened Cross Roads field pumping 20 bbl. of oil per day from the Wilcox.

SOUTH LOUISIANA

Remote Offshore Field Gets New-Pay Discovery

Continental Oil Co.'s second test in its West Cameron Block 192 field, 30 miles off the Cameron Parish coast in the Gulf of Mexico, not only is confirming discovery of the field but is opening another producing sand, approximately 300 ft. above the discovery well's pay.

Drilled to 9,300 ft. but completed in sand at 8,490-8,543 ft., the confirmation test flowed at the rate of 4,177,000 cu. ft. of gas and 61.5 bbl. of condensate per day through 16/64-in. choke with pressure of 3,275 psi.

Bottom location is approximately 2,000 ft. south and a little west of the discovery well, completed last July as a gas well in sand at 8,810-22 ft. It was drilled to 13,594 ft.

Sixth Oil Well Extends Kinder Productive Area

Sun Oil Co. has extended its Kinder field, in Allen Parish, another ½ mile to the north.

Its new extension well, 1 Edwards estate, completed in the field's 7,700-ft. reservoir, flowed 109 bbl. of 38.1°-gravity oil per day through 7/64-in. choke, with gas-oil ratio of 794 cu. ft. per barrel. Perforations are at 7,692-97 ft.

The well is the second in the 7,700-ft. reservoir, and the sixth for the field, opened last December. The discovery well produces from sand at 6,466-68 ft. Three other wells produce from an 8,000-ft. sand.

Two dry holes have been drilled but one. 1 Houston, located south of production and abandoned last January at 7,200 ft., is being reentered, and will be deepened to the 8,000-ft. sand, discovered since it was drilled.

Gulf of Mexico Wildcat Completed as Gas Well

Discovery of another field in the Gulf of Mexico off the coast of Cameron Parish has been made with the completion of a gas well by Phillips Petroleum Co. at its 2-A State Lease 1436, in Block 40, West Cameron area. Location is approximately 8 miles offshore.

No estimate of productivity has been reported, as this is written, but in a preliminary drill-stem test of perforations in Miocene sand at 10,084-93 ft. the well flowed a substantial volume of gas with 4,500 psi. working pressure, through ¼-in. and ⅜-in. chokes. The well was shut in after cleaning.

Hole had been carried to 14,072 ft. before plugging back and testing.

This is Phillips' second test on the block, the first, 1-A, having been abandoned at 11,377 ft. last March.

Third Pay Zone Opened In Rayne Extension Well

Production in the new North Rayne area is being extended more than 1 mile to the northeast in the area's third well being completed by Continental Oil Co.

The extension well, 1 Estate of J. S. Arceneaux, Sr., Inc., is productive from the Frio-Homeseekers "E" sand with perforated interval at 12,540-680 ft., a new pay zone, the third, for the field. It was drilled to 13,020 ft.

Flow on potential gage, using 12/64-in. choke, was at the rate of 314 bbl. of oil and 5,410,000 cu. ft. of gas per day with 6,700-psi. pressure.

The field was opened in December 1953. Its discovery well, 1 Petitjean, was completed in Frio-Tweedel sand at 11,905-920 ft. with a flow of 618 bbl. of 43.6°-gravity oil per day through ⅞-in. choke. Its second well, 2 Petitjean, 1,900 ft. west, completed in July, produces from the Frio-Nodosaria sand at 13,755-880 ft. Initial flow was at the rate of 156 bbl. of 45°-gravity oil daily through ¼-in. choke.

Continental has two other active operations in the area.

KENTUCKY

EASTERN KENTUCKY

On Middle Creek in Floyd County, Kentucky West Virginia Gas Co. have completed their 6210 James Hall Big Six (Silurian) wildcat as a small oil producer. Big Six sand topped at 2,552 ft. and bottomed at 2,593 ft. made, after Sandfrac, 10 bbl. of oil daily. Other important formation tops included: Maxon sand 665 ft., Big lime 828 ft., Weir sand 1,170 ft., Berea sand 1,255 ft., Devonian

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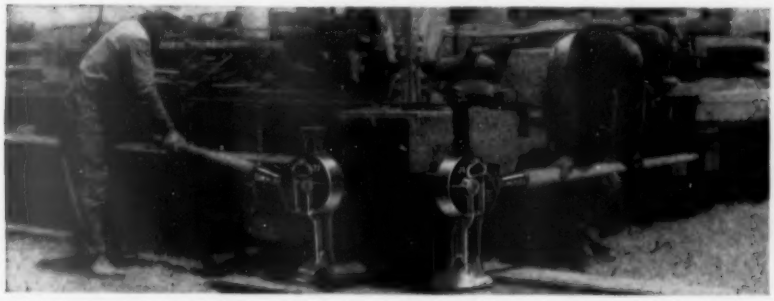

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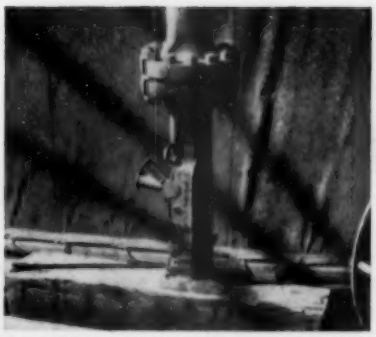

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GOTKOOL WATER COOLER
Made in 2-, 3-, 5-, 8-, 10-, 15- and 20-gallon sizes with extended or recessed push-button faucet optional. *(Note:* 15- and 20-gallon sizes available with extended faucet only.)

GOTKOOL WATER CAN
Made in 1½-, 2-, 3-, 5-, 10-, 15- and 20-gallon sizes without faucets. Extended or recessed push-button faucets available at slight additional cost. *(Note:* 15- and 20-gallon sizes available with extended faucet only.)

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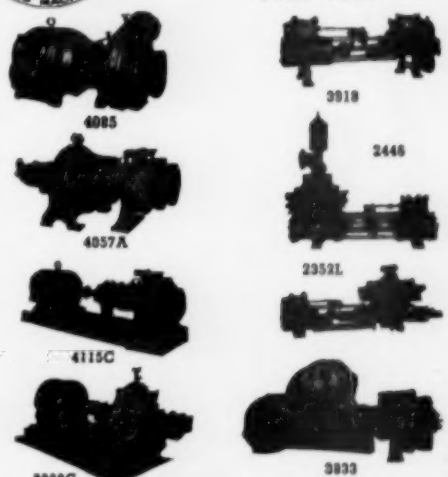
Since 1869



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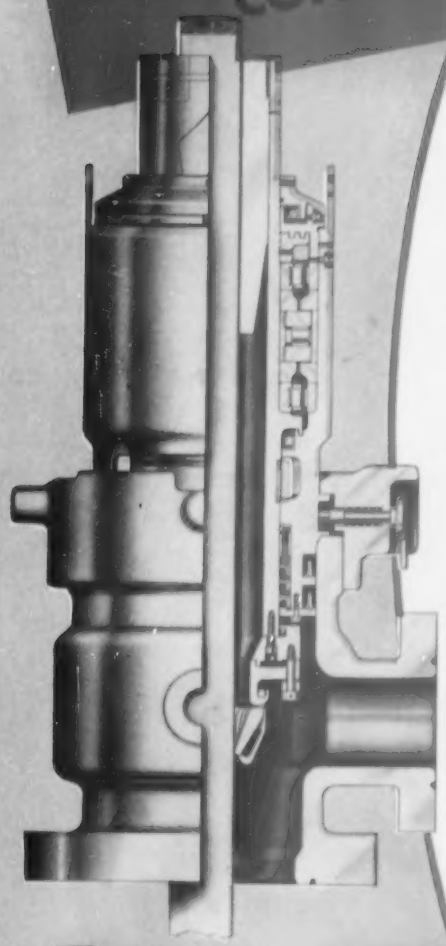
Engineered FOR BETTER PRESSURE CONTROL

is the most advanced equipment yet perfected for automatic pressure control because it embodies *so many* unique advantages in *one* unit.

Moreover, its operating simplicity is unequaled. There's nothing to remember—or forget—when pressure emergencies threaten because this unit *automatically* seals off around the drill string as soon as the tools are lowered into the well... *and maintains this pressure-tight seal—without attention—throughout all subsequent drilling operations, including the adding or removing of drill pipe.*



Two types Type 50 for drilling through 10¾" casing and larger — Type 51 for slim hole drilling, drilling-in, production jobs and remedial work. Both have some basic design features.

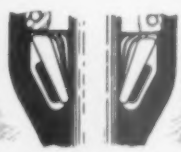
1 Space-Saving Compactness that permits installation under difficult space limitations. Even flow line connections are provided in the body—no spools or similar equipment are needed!

4 Continuous Pressure Protection is assured by the flexible Stripper Rubber which fits tightly around the drill string. No manual adjustments—no outside mechanical or hydraulic pressure—are necessary to maintain the seal while drilling, or while going into or coming out of the well.

2 Full Opening Bore is provided for passing bits, reamers and other abnormally large tools by simply rotating the bonnet 1/6 turn. This locks—or unlocks—the internal mechanism so that equipment that will pass through the casing will also pass through the unit.

5 The Stripper Rubber Rotates with the kelly—not one inside the other. Therefore, wear on the Stripper Rubber is negligible and a pressure-tight seal is maintained. In addition, all rotating loads are carried on separate thrust and radial bearings to withstand a combination of horizontal or vertical loads. Bearings are pre-packed with heat-resisting lubricant!

3 Any Shape Kelly — whether square, hexagon or octagon—is sealed off continuously while in the unit. Also, the varying diameters of the drill string—drill collars, subs, couplings, tool joints and drill pipe (whether flush joint, upset or coupled) all readily pass through the unit without losing the pressure-tight seal—because the Stripper Rubber **automatically** expands and contracts to pass them.



6 When Pulling Pipe out of the well, the Stripper Rubber continues to maintain its pressure-tight seal around the drill string while a patented barrier of steel latches prevents damage to the Stripper Rubber as couplings, tool joints and other variable diameters are pulled through it. This steel barrier also prevents the rubber from extruding under high well pressures.

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black shale 1,340 ft., and Conrniferous lime 1,940 ft.

In Magoffin County and located on White Branch, Kentucky West Virginia Gas Co. have completed 6213 Woodson Allen as a Pennsylvanian salt sand gas producer. Well gaged on open flow 1,979,000 cu. ft. of gas daily from sand topped at 1,148 ft. and bottomed at 1,166 ft.

ROCKY MOUNTAIN

WYOMING

Oil Flow Reported at Grieve Unit Discovery

Forest Oil Corp. has reported a flow of more than 1,000 bbl. of oil per day through choke of undisclosed size at 1 Morton 22-1, NE SE NW 22-32n-85w, Natrona County. The discovery, on the 25,000-acre Grieve Unit, 35 miles west of Casper is producing from a formation identified only as Cretaceous. Perforations are 6,723-80 ft. No detailed data or exact test results have been made available by the operator.

Unofficial reports have credited the discovery with a potential considerably greater than that reported, but the flow "in excess of 1,000 bbl. per day" is the only official statement.

The operator is beginning operations at two additional wells on the unit. At 2 Unit 22-2, NE NW NW 22-32n-85w, an offset will be drilled. Horizons below that now producing in the discovery will be tested at the second location, 3 Unit 29-1, C NE SW 28-32n-85w.

Hot Springs County Wildcat Apparent Discovery

Cyprus Mines Co. is preparing to test after landing casing at 4,106 ft. at 1 Rushmore, NW SE SE 2-42n-90w, in the Buffalo Springs area of Hot Springs County. The operator recovered 64 ft. of oil and 180 ft. of oil-cut mud in 2½-hour test of the zone 2,100-20 ft. in Phosphoria. Completion will be in open hole. The first was a failure.

Shows Reported at Sherwood Unit Wildcat

Stanolind Oil & Gas Co. has reported recovery of gas and oil and gas-cut mud on test of Frontier at 1 Sherwood Unit, C SE NW 3-40n-77w, Natrona County. Test of the zone 9,633-62 ft. had gas in 22 minutes, with the rate of flow not measured. Pipe recovery was 180 ft. of oil and gas-cut mud. Tool was open 1 hour.

Sheridan County Discovery Swabbing

Shell Oil Co. is swabbing at the rate of 15 bbl. of fluid per hour at 1 Hullworth, SE NE NE 31-58n-84w, in the Decker area, Sheridan County. The wildcat, about 2½ miles southeast of production in Ash Creek field made 3,760 ft. of free oil on test of the Ash Creek sand. No breakdown of the current swab recovery has been reported by Shell. The oil recovery was on test of the interval 4,885-4,905 ft., with tool open for 45 minutes. A 1-hour test 4,902-50 ft. recovered 1,653 ft. of oil.

The well is the first discovery in the area by Shell in its own right as operator. The Ash Creek field discovery was made by J. Ray McDermott & Co. on land farmed out by Shell, and the company has drilled several previous wildcats in the area without success.

Carbon County Wildcat Flows Gas

J. Ray McDermott & Co. recovered gas at the estimated rate of 2,000-3,000 M.c.f. per day on drill-stem test of 1 South Baggs, Government, C NE NW 9-12n-92w, Carbon County. Test 4,686-97 ft. flowed gas after 1 minute. Tool was open 1 hour, and flowing pressure decreased from 218-172 psi. Another test 4,697-4,762 ft. flowed in 40 seconds, and was also of 1-hour duration. Pressure was 238 to 145 psi. There was no recovery in pipe on either of the tests.

WESTERN NEBRASKA

Two Kimball County Discoveries Tested

Don Rounds and others of Denver recovered oil on test of 1 Leonard, NW NW NW 7-12n-55w, Kimball County. Test of the "J" sand at 6,451-91 ft. recovered 970 ft. of oil and 180 ft. of oil and water-cut mud in 1 hour The operators are running casing. The well is about 3 miles west of Long field, one of the most productive in area.

Gem Oil Co. recovered 420 ft. of oil and 300 ft. of oil-cut mud on test of 1 Woten, NE NE NW 29-16n-52w, Kimball County. This well is about 7 miles north of the town of Potter, in an area which has no previous production. Recovery at this wildcat was also from "J" sand at 5,453-70 ft. and tool was

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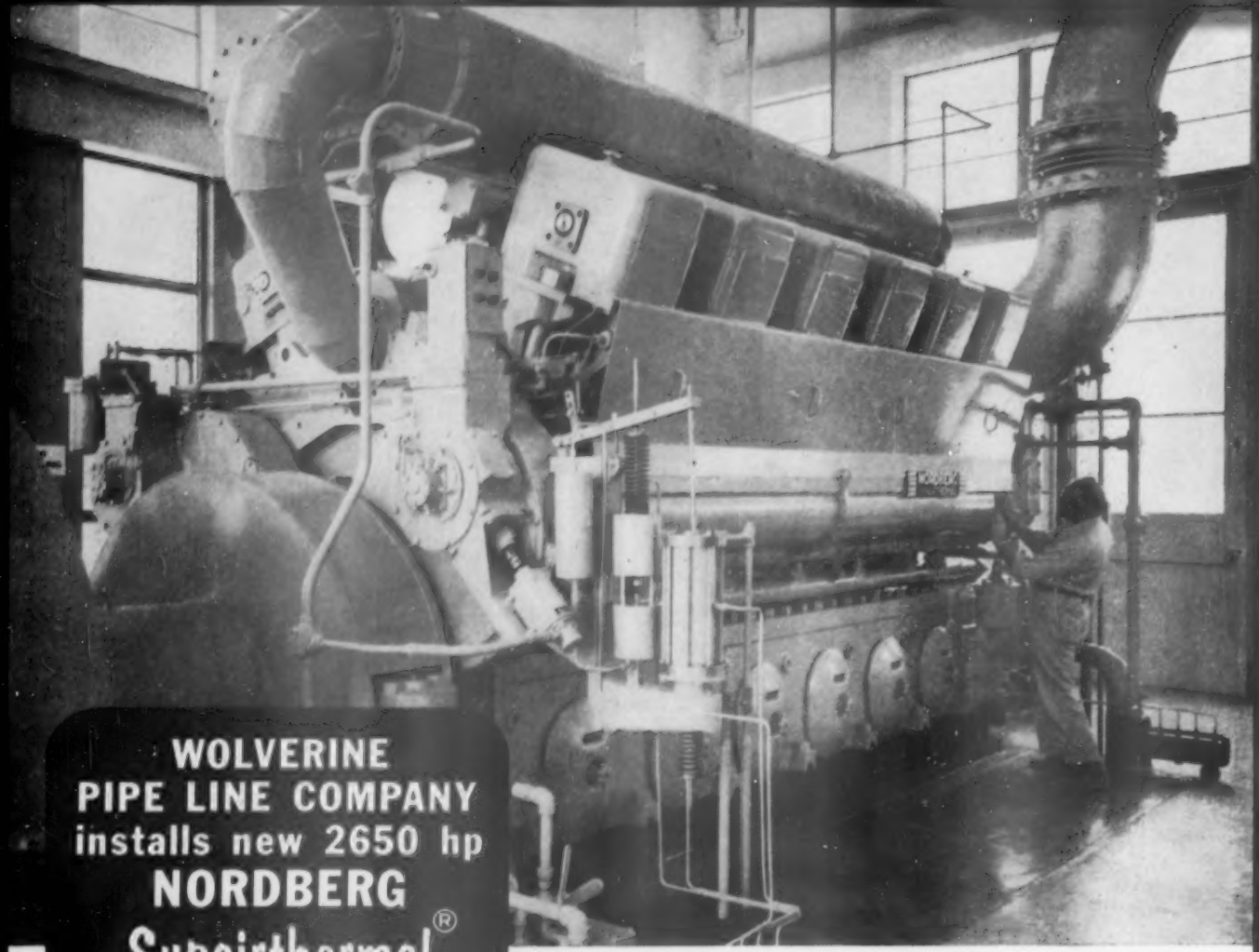

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open for 2 hours. At last report, Gem was drilling below 5,490 ft.

COLORADO

Jackson County Wildcat Recovers Oil

Lion Oil Co. has recovered oil on drill-stem test of Frontier (?) sand at 1 Dwinnell, C NE SW 23-10n-79w, Jackson County. Test was at 3,872-3,917 ft. and with tool open for 80 minutes, recovery was 1,140 ft. of oil and 180 ft. of oil and gas-cut mud. Gas flowed during the test at the estimated rate of 100,000 cu. ft. per day. Flowing pressure was 50-425 psi. The operator is drilling below 4,000 ft. The wildcat is about 2 miles north of the McCallum Unit, in an area which has had little previous drilling.

"J" Sand Discovery Indicated In Morgan County

British-American Oil Producing Co. has tested a wildcat west of Adena field in Morgan County with apparently commercial results. The well is 1 Hegarty, C NW SE 26-1n-59w. Oil flowed after 1 hour from the interval 6,198-6,215 ft. The zone is in "J" sand.

The apparent discovery is about 5½ miles west of production in the southern portion of Adena field. Cores indicated about 15 ft. of apparently productive sand, and the operator was continuing tests at last report.

La Plata County Gas Discovery Tested

Southern Union Gas Co. had a flow of 3,000 M.c.f. of gas per day on test of 1 Vorbeth Land, SW NE NE 22-32n-11w, La Plata County. The well produced from the interval 5,295-5,650 ft. Top of Cliffhouse was called at 4,895 ft. Pictured Cliffs top was found at 5,320 ft. The well is about 1½ miles southwest of South Red Mesa gas production. The operator is active at two other locations in the area.

MONTANA

Fallon County Discovery Testing

Shell Oil Co. tested a flow of 528 bbl. of fluid per day at 14-34 Unit, C SW SW 34-5n-61e, in the MDU area of Fallon County. Test was of the interval 8,203-8,375 ft., in open hole. Of the total recovery, 264 bbl. was oil. Test followed treatment of the formation (Ordovician) with 2,000 gal. of acid. Before treatment, Shell swabbed at the rate of 144 bbl. of fluid per day, with only 1 bbl. of water in the total recovery. The well made apparently commercial quantities of oil on drill-stem test of Mississippian zones, in addition to Ordovician shows. The upper horizon has not been tested since pipe was set.

NORTH DAKOTA

Bottineau County Extension Being Completed

Cardinal Drilling Co. recovered 466 ft. of oil at 1 Steen, SE NE 31-164n-78w, extension to Northwest Landa field, Bottineau County. Test was of the interval 3,051-61 ft., and tool was open for 4 hours. Gas flowed after 32 minutes of the test, and there was a strong blow throughout. The operator is re-

ready for 'round-the-clock PRODUCTION PUMPING

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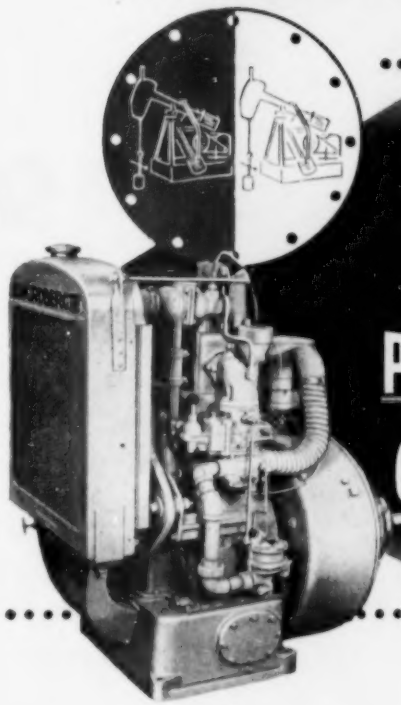

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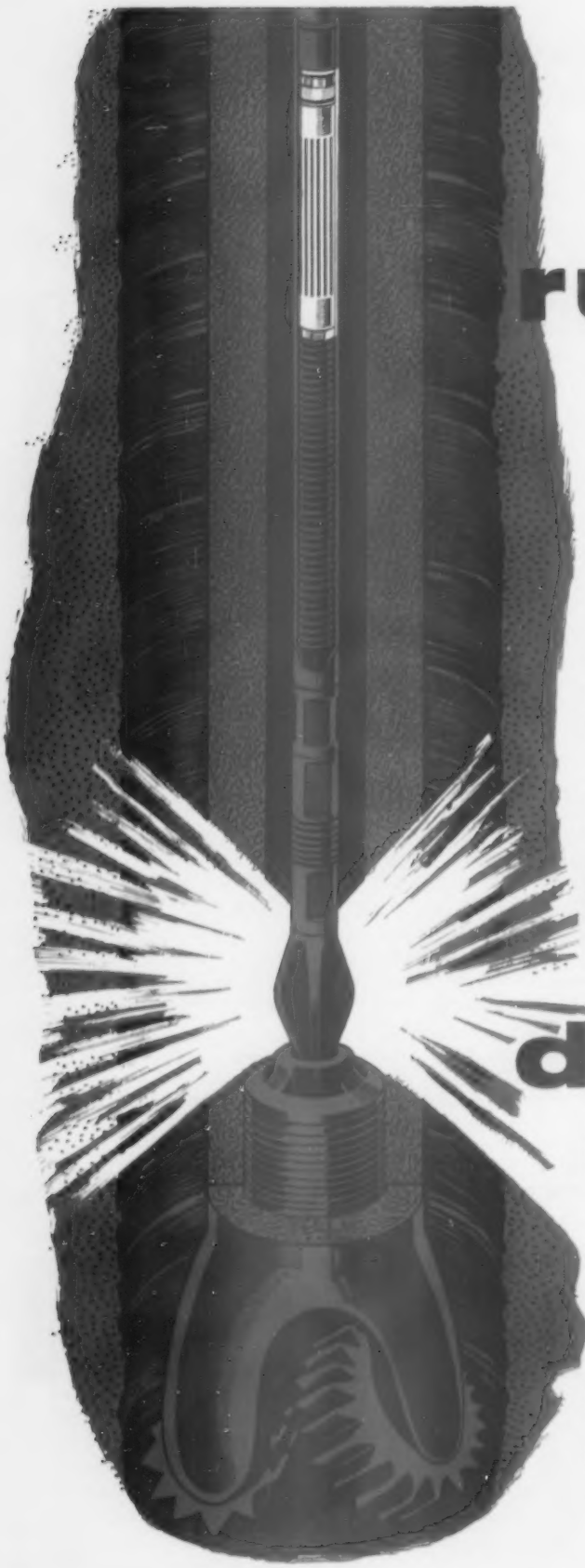

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ported running casing at the well, which is about ¾-mile northeast of previous production in the area.

MICHIGAN

Another natural-flowing Traverse oil well was being tested this week in Sumner pool, Gratiot County, at the I. W. Hartman and Columbia Oil & Gas Co. 2 Wilson, et al., SE NW SW 11-11n-4w.

Well, which flowed as much as 66 bbl. of oil natural in 19 hours through a restricted choke, was said to be good for at least 40 bbl. of oil an hour on an open flow rate, but well will not be produced at a rate in excess of the 75-bbl. a day allowable set for the pool.

Top of Traverse lime was logged at 2,791 ft., and Alpena Traverse, the pay zone, was topped at 2,827 ft. Pay showed at 2,847-48 ft. This new producer is the west 10-acre offset to same operator's 1 Coburn, first natural-flowing well in Sumner pool.

Deepened in the Trenton to 4,508 ft., David J. Shiffman 1 Dolan Bros., NE NE SE 2-1s-7e, Salem Township, Washtenaw County, a new completing well on the west side of Northville pool, appeared to have picked up a water sand at that point. Well first encountered oil pays at 4,484-87, and 4,498-4,500 ft. Well flowed 28 bbl. of oil in 1 hour through a highly restricted choke on only reported test. Hole was plugged back to shut off this week. However, there were some observers in the pool who did believe that water had been found at 4,508 ft. at the 1 Dolan Bros.

This well is the direct south 10-acre offset to the 1 Nerreter well which was the well in the area to log an oil pay below the point where the 1 LeMaster discovery drilled its prolific flowing pay. This west-side pay zone, now known to be present in two wells, may be in the Black River formation below the Trenton. A shale break was encountered in these wells which may be the dividing line between the Trenton and the Black River formations. Geologists, without the benefit of extensive samples for study, are not yet in general agreement as to whether this second pay horizon is in the Trenton or in the Black River formation.

WILDCAT COMPLETIONS

SOUTHWEST TEXAS
District 1

Atascosa County: Thomas Brothers et al 1 Smith, Block 11, I&GN Sur. 1749. Dry. TD 1,588 ft.

Bastrop County: Mid-Tex Drilling Co. 1 Erhard, James Stewart Sur. Temporarily abandoned. TD 850 ft.

Caldwell County: Rand Morgan 1 P. S. King, Jr., Sampson Connell Sur. Dry. TD 1,991 ft.

Frio County: C. G. Dunwoody, Jr., 1 Riley, John Chaffin Sur. 317, A-162. Dry. TD 4,905 ft.

Gonzales County: Producers Corp. of Nevada et al 1 New, Eli Mitchell Sur. A-337. Dry. TD 2,282 ft.

LaSalle County: Henderson Coquat et al 1 Boeker, I&GN Sur. 41, A-425. Dry. TD 5,195 ft.

Milam County: Group Oil Co. 1 Huffman, James Reed Sur., A-48. Dry. TD 3,215 ft.

Travis County: Dan M. Covert 1 Carlson, L. Kimbro Sur. Dry. 750 ft.

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Even with all the latest scientific methods at their disposal, oil men cannot always be certain of a black-gold find beneath strange lands. What is important is that Cities Service, as well as the rest of the industry, is willing to risk huge sums on any reasonable evidence that they may find oil.

One company may decide not to drill an area, while another will say, "Let's take the risk." This is gilt-edge assurance to the nation that every possible area will be explored. It's a marvelous example of how our free enterprise, competitive system constantly influences all American business in a direction that will always benefit the consumer.

Cities Service will continue to make new oil finds to help fill the oil larders of the nation . . . known underground oil supplies are over four times what they were thirty years ago. Cities Service will continue to drill dry wells too . . . the odds are 8 to 1 against bringing in a producing discovery well. And these hundreds upon hundreds of dry wells, with the millions of dollars spent on them, will in themselves serve as a monument to the constant efforts of the American petroleum industry to keep our country strong and to keep our standard of living at the highest point the world has ever known.

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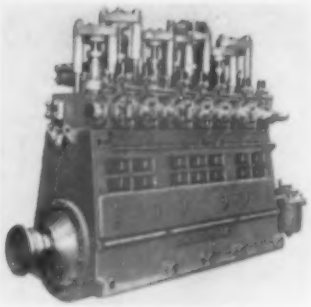

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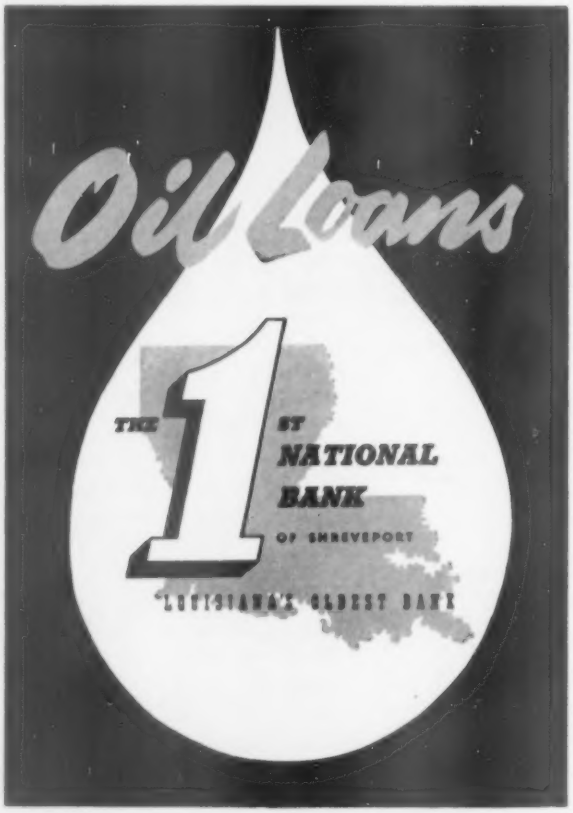


WILDCAT COMPLETIONS

Crosby-Hiblack-De Santo 1. Johnson, L. Kimbro Sur. Dry. TD 850 ft.

District 4

Brooks County: Mills Bennett estate 10 Mills Bennett estate fee, Juan Jose Guerra Grant, A-257. IP 85 BOPD, ⅜-in. 40.3°, perforations 3,820-28 ft. TD 6,015 ft. (New pay in Mills Bennett field.)

Jim Hogg County: Gorman & DeLange 2 Pilar G. de Garza, William Key Sur. 269. Dry. TD 2,474 ft.

Kleberg County: Humble Oil & Refining Co. 2 King Ranch-Alazan, El Alazan Grant. IP 27 BOPD, net, ⅜-in., 47.3°, perforations 5,748-56 ft. TD 11,958 ft. (New field-Alazan.)

Nueces County: Sam Krasner and L. L. Woodman 1-A Taylor Brothers, Tract A, Section 50, Laureles Farm Tracts. Dry. TD 7,524 ft.

San Patricio County: H. H. Howell and William H. Winn 1 Luther et al, Lot 12, Mathis Land & Town Subd., Ed J. McGloin Sur. Dry. TD 4,783 ft.

Starr County: Blair-Vreeland 1 Bentsen et al, Lot 13, Block 6, Las Magueyes Grant. IP 10,500 M.c.f. daily, 6 BC per M.M.c.f., open-flow potential, 65.7°, Frio 4,906-14 ft. (perforations). TD 6,294 ft. (New field—Hinde.)

Willacy County: Superior Oil Co. 2 Yturria, San Juan de Carricitos Grant, A-8. IP 70 BOPD, net, ⅛-in., 40.5°, perforations 6,411-21 ft. TD 7,700 ft. (New pay in La Sara field.)

TEXAS GULF COAST

District 2

Jackson County: Magnolia Petroleum Co. 1 Peters, F. G. Keller Sur., A-38. Dry. TD 4,810 ft.

Karnes County: Seaboard Oil Co. 1 Szalwinski, Luis Manchaca Sur. A-5. Dry. TD 11,800 ft.

Live Oak County: Texita Oil Co. and W. M. Averill, Jr., 2 Tom Slick, Victoria Chapa Sur. 320, A-739. Dry. TD 2,864 ft.

District 3

Austin County: Adams & Haggarty 1 Wittneben et al, John Hodge Sur., A-49 (Brenham Dome). Dry. TD 9,155 ft.

Chambers County: Charles H. Osmond, Hill & Hill, and A. W. Cherry 1 Canada, G. W. Shelton Sur., A-384. Dry. TD 9,226 ft.

Wesley West 1 Boyt et ux, T&NO Sur. 25, A-262. IP 20,000 M.c.f. daily, open-flow potential, GCR 8,720 cu. ft. per barrel, 55.3°, basal Frio 8,755-61 ft. (perforations). TD 8,780 ft. (New field—Walla Boyt.)

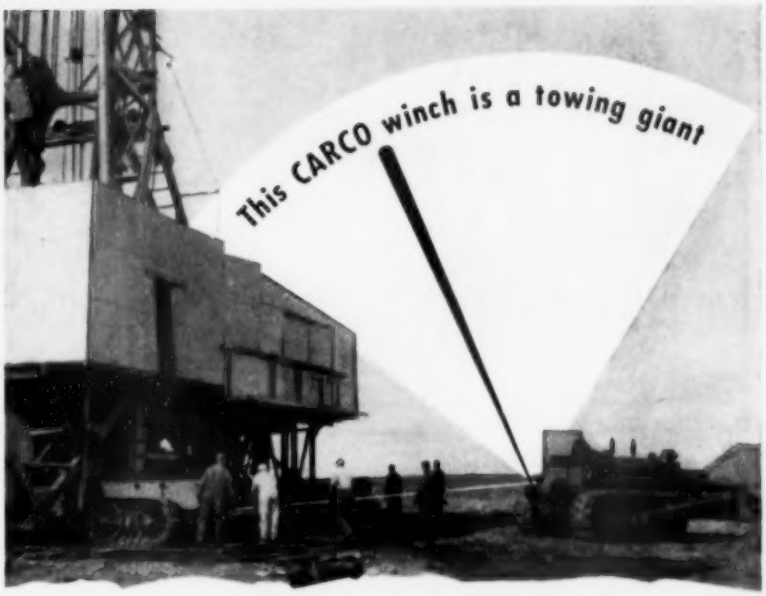
Galveston County: John W. Mecom 3 Ervine & Bishop, Alex Farmer Sur., A-11. Dry. TD 11,307 ft.

Harris County: Oil Operations, Inc., 1 Blakeney, Ritson Morris Sur., A-52. Dry. TD 9,214 ft.

Panuco Oil Leases, Inc., 1 Rogers et al, Block 2, J. A. Arnold Sur. 22, A-1337. Dry. TD 7,717 ft.

I. Rauch, trustee, 22 House, Mary Owens Sur. IP 165 BOPD, 14/64-in., 33°, casing perforations 4,108-32 ft., and 126 BOPD, 12/64-in., perforations 4,154-64 ft. TD 4,554 ft. (New pay—4,154-64 ft. sand—in Humble field.)

C. B. Webster 2 Hinkle estate, William Hieronymus Sur., A-352. IP 17,000 M.c.f. daily, open flow, with 11 BC per million cubic feet, Cockfield 5,810-13 ft. TD 7,235 ft. (New field.)



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Mr. Mendenhall states that Carco winches are more compact and better constructed. In over 2000 hours of rough, tough work, maintenance expense has been zero.

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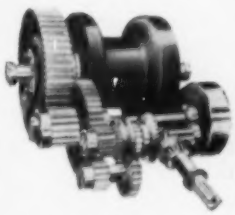

Doubling the pulling power of the most powerful crawler tractors calls for a gear train that's tough and rugged. The Carco Model J winch converts tractor power into line pull efficiently and directly through a 4-stage constant mesh gear train. The doubled line pull is made possible by a high ratio of gear reduction. As faster line speed is generally desired for paying out the line, a lower gear ratio is provided in reverse. Heavy-duty gears and shafts of heat-treated special alloy steel guarantee a large overload capacity. Precision cut, gears and shafts, with anti-friction bearings, operate in a continuous oil bath.

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FOR ALL INDUSTRIAL TRACTORS

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THEY KNOCKED GRAMPAW LOOSE!! NOW, THEY'RE FISHING HIM OUT WITH THAT JOHNSTON JAR!!
IT DOES BOTH JOBS!!
IT HIT WITH JUST THE RIGHT FORCE, TO LOOSEN HIM WITHOUT HURTING HIM!!-
THOSE JOHNSTON BOYS ARE AVAILABLE FOR ANY TESTING JOB -AND THEY DO IT SO ACCURATELY!
C-544
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first in drill stem testing

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FORMATION AND CASING TESTING — JOHNSTON

WILDCAT COMPLETIONS

Jasper County: American Republics Corp. 1-D Hankamer et al, H&TC Sur. 75, A-282. Dry. TD 8,541 ft.

Madison County: Woodley Petroleum Co. et al 1 Fannie-Cannon unit, John Crownever Sur., A-12. Dry. TD 10,285 ft.

Matagorda County: Edwin L. Cox 1 Hansen, Block 7, I&GN Sur. 3, A-231. Dry. TD 8,800 ft.

Orange County: John W. Mecom 1-A Powell, R. Ballew Sur., A-2 (Echo area). Dry. TD 8,884 ft.

Waller County: Humble Oil & Refining Co. 1 Jones, William Cooper Sur., A-20. IP 38 BOPD, ⅛-in., 31.1°, perforations 6,842-60 ft. TD 8,165 ft. (New field.)

Wharton County: Caroline Hunt Sands 1 Zaruba, Block 5, BBB&C Sur., A-81. Dry. TD 6,183 ft.

Smith & Smith 1 Cockburn, Block 6, S. Castleman Sur. 5, A-12. IP 139.21 BOPD, 8/64-in., 28.9°, Marginulina 5,448-52 ft. (perforations). TD 5,490 ft. (Extends Lane City field, between Lane City and Prasifka fields.)

EAST TEXAS

Anderson County: Jack & Delbert Powell 1 Davey, Moses Woodard Sur., A-811, 3 mi. SE Elkhart. Dry. TD 6,103 ft.

Ellis County: H. L. Enos 1 Taylor, T. J. Chambers Sur., A-1, 12 mi. SE Ennis. Dry. TD 2,180 ft. Woodbine 2,156 ft.

Harrison County: Gilster & Kemp 1 Allen, George English Sur., offset to discovery. Dry. TD 6,886 ft.

J. E. Prothro 1 Furrh, J. Mathews Sur., A-466, 1 mi. W Wasom field. Dry. TD 6,416 ft.

Henderson County: Cities Service Oil Co. 1 Briggs, Phillip Jackson Sur., A-392. Dry. TD 5,455 ft.

Houston County: Geier-Jackson, Inc. 1 Bridges, S. C. Collison Sur., A-241, 12 mi. NW Grapeland. Dry. TD 5,970 ft.

Hunt County: B. B. Banner 1 Ott, J. Heller Sur., 6 mi. NE Greenville. Dry. TD 3,000 ft.

Leon County: Carter-Gragg Oil Co. 2 Carter, Hiram Little Sur., A-511, 5½ mi. SE Oakwood. Dry. TD 10,485 ft.

Limestone County: W. A. Reiter 2 Norris, H&TC Sur., 4 mi. NW Thornton. IPP 23.7 BOPD, 38°, Wolfe City pay 2,027-36 ft. TD 2,040 ft.

Van Zandt County: Arcadia Refining Co. and Cascade Petroleum Co. 1 Mislovitts, I. Killough Sur., A-452, 8 mi. SW Wills Point. Dry. TD 4,448 ft.

TEXAS PANHANDLE

Ochiltree County: The Texas Co. 1 Daniel "A", 4T-139-T&NO. IP 9,140 M.c.f. of gas per day, 7,343-51, 7,551-60 ft. TD 10,181 ft. (Gas discovery)

WEST CENTRAL TEXAS

Brown County: Stuart Lydick 1 Riordon, C. B. Jennings Sur. 353. Dry. TD 2,400 ft.

Callahan County: Butler & Peebles 1 Waggoner, Sec. 67, BBB&C Sur. Dry. TD 1,845 ft.

A. E. Lynch 1 Gilliland, 27-5-SPRR. Dry. TD 862 ft.

James P. McHargue 1 Nichols, Sec. 28, D&A Sur. Dry. TD 1,145 ft.

R. W. McKissick 1 Specks, 2-1-SPRR. Dry. TD 2,000 ft.

Onyx Oil Co. 1 Dyer, Sec. 13, ETRR Sur. Dry. TD 1,318 ft.

Woodson Producing Co. 1 Cutbirth, Bartola Garcia Sur. 208. Dry. TD 2,386 ft.

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Will not stick or freeze. Perfect for hard-to-hold fluids. Simple plug adjustment nut eliminates sticking

Hamer Line Blinds are unsurpassed for positive action, easy operation, long-life service and lasting safety. One man can open or blind a line in less than one minute, and there is nothing like a solid plate for a **permanent leakproof shut-off.** Bar or handwheel operation eliminates wedges, hammers, wrenches needed for spreading conventional flanges. Removes fire hazard of sparking and stops damage to equipment.

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WILDCAT COMPLETIONS

Woodson Producing Co. 2 Moore, Sec. 1, J. W. Scott Sur. Dry. TD 1,950 ft.

Coleman County: A. B. See Drilling Co. 1 Freeman, J. H. Gibson Sur. 4 Dry. TD 3,915 ft.

Frank Ausanka 1 Edington, H. L. Marshall Sur. 173. Dry. TD 3,300 ft.

G. W. McCoy 1 Hargett, R. S. Bowen Sur. 2. Dry. TD 3,002 ft.

Rex McFall and Elam & Davis 1 Bailey, Sec. 15, HT&B Sur. Dry. TD 2,400 ft.

Kenneth A. Swanson 1 Edington, D. Scannell Sur. 484. Dry. TD 1,982 ft.

Jones County: B. Baldridge 1 Hodges, 51-15-T&P. Dry. TD 2,176 ft.

Fletcher Oil & Gas Drilling Corp. 1 Parham estate, Sec. 39. OAL Sur. Dry. TD 2,978 ft.

A. T. Halbert-Evetts-Dillard 1 Turner, Sec. 7, OAL Sur. Dry. TD 2,280 ft.

Stephens County: Menefee & Parsley 1 Pitts-Bradford, 69-6-T&P. Dry. TD 2,200 ft.

Taylor County: Allison-Prestridge-West Central Drilling Co., and Wayne Petroleum Co. 1 Wilkinson, L. Hargis Sur. 407. Dry. TD 4,372 ft.

King & Herring 1 Graham, H. Corzine Sur. 508. Dry. TD 4,633 ft.

NORTH TEXAS

Archer County: M. W. Blair 2-A Cowan-McKinney, Blk. 151, R. Carson Subd. Dry. TD 1,494 ft.

Double L Drilling Co. 1 Parkey, Blk. 38, Dallas CSL Sur. Dry. TD 1,560 ft.

Quincey J. Lee 1-A Perkins, Blk. 37, J. J. Perkins Subd. Dry. TD 1,525 ft.

Bill Lisle 2 Meade estate, Blk. 35, L. M. Meade Pasture Subd. Dry. TD 1,518 ft.

Baylor County: Archer Drilling & Production Co. 2-E Mills, TE&L Sur. 2414. Dry. TD 1,426 ft.

Archer Drilling 3-E Mills, TE&L Sur. 2414. Dry. TD 1,422 ft.

Archer Drilling 4-E Mills, TE&L Sur. 2414. Dry. TD 1,495 ft.

Archer Drilling 5-E Mills, TE&L Sur. 2414. Dry. TD 1,436 ft.

Archer Drilling 6-E Mills, TE&L Sur. 2414. Dry. TD 1,431 ft.

Clay County: L. T. Burns 1 Jackson, L. Jones Sur., A-266, 2 mi. NW Shannon. IPP 92 BOPD, 42°, Strawn perforations 4,186-96 ft. TD 4,845 ft.

Robert S. Davis 1 Lyon estate, Blk. 91, Byers Bros. Subd. Dry. TD 2,166 ft.

Edgar A. Smith 1 Moser, Sec. 101, Angelina CSL Sur., A-3. Dry. TD 6,513 ft. Caddo 6,103 ft., Simpson 6,301 ft.

Denton County: Felderhoff Bros. 1 Wilson, J. B. P. January Sur., A-658. Dry. TD 1,652 ft.

Jack County: British-American Oil Producing Co. 2 Berry, M. Anderson Sur., A-21. Dry. TD 2,065 ft.

E. B. Clark Drilling Co. 1 Wolf, Derrick Sur., A-1608. Dry. TD 3,279 ft.

Cullum Bros. Production Co. 1 Barrick, Blk. 23, J. Robbins Sur. Dry. TD 3,953 ft. Bryson sand 3,837 ft.

Mid-Continent Petroleum Corp. 2 McNeely, L. M. Broadstreet Sur., A-1034. Dry. TD 3,490 ft.

Knox County: Burt Oil Co. and D. P. Stephenson 1 Burns, 21-2-D&W Sur. Dry. TD 5,855 ft.

Young County: R. W. Darden 1 Logan, TE&L Sur. 2448. Dry. TD 1,277 ft.

Merle F. Gunby 1 Griffin, J. L. Lane Sur., A-1737. Dry. TD 4,637 ft. Ellenburger 4,582 ft.

W-M Co. 1 Howard, Sec. 1461, TE&L Sur. Dry. TD 892 ft.

WEST TEXAS

Dawson County: Magnolia Petroleum Co. 1 Foster, 22-36-T4N-T&P. Dry. TD 11,916 ft. Elev. 2,903 ft., Pennsylvanian 10,067 ft., Fusselman 11,850 ft.

Garza County: John C. Head Jr. 1 Gossett, 12-5-K. Aycock Sur. Dry. TD 4,234 ft.

Glasscock County: Hunt Oil Co. 1 Houston, 22-35-T2S-T&P. Dry. TD 11,400 ft. Elev. 2,543 ft., Wolfcamp 8,170 ft., Simpson 11,382 ft., Montoya 11,049 ft.

Hockley County: Great Western Drilling Co. 1 Scheid, 5-16-Howard CSL. Dry. TD 6,229 ft. Elev. 3,451 ft., Clear Fork 6,050 ft.

Howard County: Amerada Petroleum Corp. 1 Whitaker, 17-25-H&TC. Dry. TD 8,893 ft. Elev. 2,442 ft., Strawn 7,947 ft.

Callihan Rotary Co. 1 Creighton, 29-33-T1N-T&P, 3 mi. W Big Spring. IPP 164 BOPD, 38°, GOR 375 cu. ft., pay 3,025 ft. TD 3,065 ft.

Harper & Huffman 1 Oldham, 41-27-H&TC. Dry. TD 9,410 ft. Elev. 2,573 ft., Ellenburger 9,365 ft.

Pecos County: Fullerton Oil Co. et al 1 Pecos Valley "BF", 22-10-H&GN. Dry. TD 5,960 ft. Elev. 2,449 ft., Montoya 5,925 ft.

Reeves County: Sun Oil Co. 1 Balmorhea Ranches, 176-1-H&TC. Dry. TD 5,491 ft. Elev. 2,904 ft., Delaware sand 5,239 ft.

Schleicher County: H. R. Mock 1 Thompson heirs, 71-A-HE&WT. Dry. TD 646 ft.

Scurry County: Progress Petroleum Co. of Texas 1 Whatley, 504-97-H&TC. Dry. TD 7,415 ft. Elev. 2,504 ft., reef 6,990 ft.

Sunray Oil Corp. 1 Criswell, 212-2-H&TC. Dry. TD 7,230 ft. Elev. 2,133 ft., Pennsylvanian reef 6,246 ft., Devonian 6,786 ft., Ellenburger 7,152 ft.

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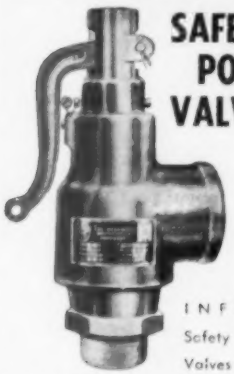

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WILDCAT COMPLETIONS

Tom Green County: R. J. Caraway and C. B. Drilling Co. 1 West, 46-25-H&TC. Dry. TD 5,360 ft.

R. J. Caraway and C. B. Drilling Co. 2 West, 46-25-H&TC. Dry. TD 386 ft.

Chambers, Kennedy & White Eagle 1-B Johnson, 43-25-H&TC. Dry. TD 5,960 ft.

Childress Drilling Co. 1 DeWolf, 58-25-H&TC. Dry. TD 6,297 ft.

Sid Katz 1 Johnson, J. M. Swishen Sur. 79½, A-7954. Dry. TD 6,500 ft.

C. L. Norsworthy Jr. 1-A Robertson, 9-22-H&TC. Dry. TD 6,091 ft.

Upton County: Phillips Petroleum Co. 1-B Dodson, 103-D-CCSD&RGNG. 15 mi. NW Rankin. IP 21,500 M.f.g., plus 21.8 bbl. distillate, GOR 9,720 cu. ft., TP 2,608 psi., Strawn pay 9,840 ft. TD 11,791 ft.

Menard County: Tucker Drilling Co. 1 Mary Rogers, 5-B-GH&SA, 16 mi. N Ft. McKavett. IPP 178 BOPD, 40°, GOR 100 cu. ft., Cisco pay 2,780 ft. TD 2,825 ft. Tucker pool.

WEST TEXAS BORDER COUNTIES

Coke County: C. L. McMahon, Inc. 1 Hendry, J. Holloman Sur. 305, 3 mi. SE Blackwell. IP 141.7 BOPD, 13/64-in., 43°, GOR 1,558 cu. ft., TP 460 psi., Gardner perforations 5,346-53 ft. TD 5,823 ft.

Garrett M. Smith and R H R Oil Co. 1 Farries, 446-1A-H&TC. Dry. TD 4,101 ft.

Fisher County: General Crude Oil Co. 1 Ray, Bastrop CSL Sur. Dry. TD 6,538 ft.

Nolan County: Harper & Huffman 1 Sears, 138-1A-H&TC. Dry. TD 7,580 ft. Elev. 2,531 ft., Ellenburger 7,060 ft.

Runnels County: Thos. D. Humphrey & Sons 1 Norton Properties, Burnett CSL Sur., A-19. Dry. TD 4,488 ft.

O. P. Leonard 1 Walter Adami, J. J. Ximenez Sur. Dry. TD 4,374 ft.

Stonewall County: Ada Oil Co. 1 Anderson, 195-D-H&TC. Dry. TD 6,690 ft.

Pure Oil Co. 1 Wilson, 98-F-H&TC. Dry. TD 6,560 ft. Elev. 1,736 ft., Cambrian 6,550 ft.

SOUTHEAST NEW MEXICO

Lea County: Union Oil Co. of California 1 Gilmore, 21-22s-32e. Dry. TD 8,770 ft. Elev. 3,678 ft., Bone Springs 8,617 ft., Delaware limestone 4,690 ft., sand 4,738 ft.

NORTHERN NEW MEXICO

Colfax County: Continental Oil Co. 1 St. Louis, Rocky Mountain & Pacific Co., SW SE 13-30n-22e. Dry. TD 5,185 ft. Penn.

Rio Arriba County: Southern Union Gas Co. 1 Jicarilla, SE NW SW 1-26n-5w. IP 1,227 M.c.f. of gas per day, Mesaverde discovery, new field. TD 5,775 ft. Point Lookout.

San Juan County, Northwest Hogback: Stanolind 1 Navajo, SE NW NW 12-29n-17w. Dry. TD 7,215 ft. Miss.

MICHIGAN

Isabella County: Neyer, Miller & Gallagher 1 Kidder et al, S½ SE SW 20-16n-5w. Dry. TD 1,439 ft. in Brown lime.

Kent County: Clarence N. Crawford 1 Felt, SW NE NE 4-8n-12w. Dry. TD 2,729 ft. in Dundee.

Osceola County: William Cline 1 Johnson, S½ SW SE 8-18n-10w. Dry. TD 3,597 ft. in Traverse lime.

Ottawa County: Miller Brothers 1 Rasmus, SW NW SW 4-8n-14w. Dry. TD 1,937 ft. in Traverse lime.

WESTERN KENTUCKY

Christian County: Morgan Bros. 1 Wells, SE NW SW SW 25-H-27. Dry. TD 764 ft.

Union County: J. P. Grandin 1 Woods, NE NW NE SE 25-O-19. Dry. TD 2,310 ft.

WEST VIRGINIA

Hardy County, Moorefield district: Baker & Hershberger 1 Thomas Williams, elevation 949 ft. Dry. Medina sand, Oriskany sand 594 ft., Clinton sand 3,315-3,807 ft. TD 3,962 ft.

ALABAMA

Conecuh County: George D. Hunt 1 McMillan-Day unit, NE SE 9-4n-10e. Dry. TD 5,350 ft. Elev. 261 ft. Lower Cretaceous 5,120 ft.

Escambia County: Gulf Refining Co. 2 Alger-Sullivan, SE NE 16-3n-7e. Dry. TD 5,946 ft. Elev. 236 ft., lower Tuscaloosa 5,533 ft., Massive 5,705 ft.

MISSISSIPPI

Wilkinson County: H. L. Rowley 1-A Armstrong, 10-4n-2w. Dry. TD 7,308 ft. Elev. 77 ft., Wilcox 4,800 ft., base Baker shale 6,561 ft.

David Sadler 1 Kee, NE NE 29-3n-4w. IP 124 BOPD, 6/64-in., 45°, Wilcox 7,645½-50½ ft. (perforations). TD 7,754 ft. Elev. 49 ft., Wilcox 5,542 ft., base

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Spang & Co.
P. O. Box 571
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Attention: Sales Manager

Gentlemen:

Last summer we purchased a set of your 8" Molloy Bits.

We have used these bits on a number of wells in the San Andres lime which is a very hard formation and a good formation to test the quality of steel in bits. Our experience with the Molloy Bits has been quite satisfactory and so far we have not jumped a pin off of these bits. With other bits we ordinarily jump one or more pins on each well we drill.

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We are well pleased with the bits and it is our plan to replace our other bits as they wear out with the Molloy Bits.

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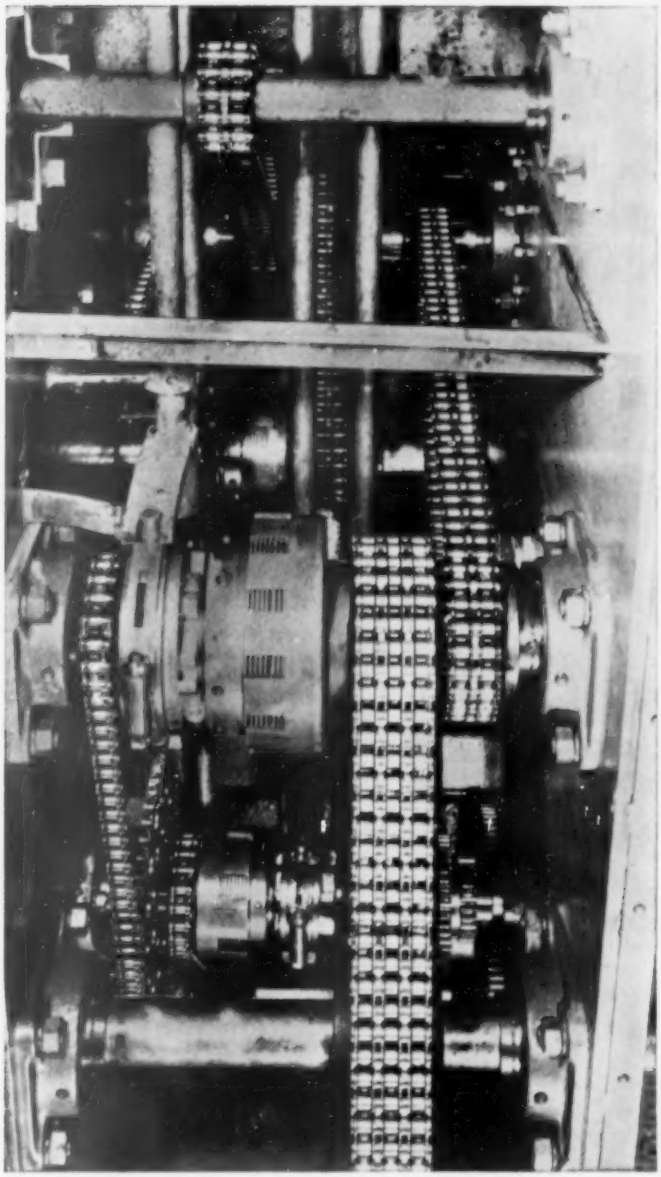
How Morse figures in a special feature of shot-hole and water-well drilling



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The gear box incorporates single- and multiple-width Morse Roller Chains and Sprockets; Morse Roller Chain Couplings contribute to the drill's rated drilling depth of 1,000 feet, with a 6" hole.

Morse Roller Chains contribute stamina and long service life to any machine on which they are used. They are used to transmit power reliably, efficiently, and economically. They are trouble-free in operation and help reduce maintenance costs.

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WILDCAT COMPLETIONS

Baker shale 7,368 ft. (New field—Lake Mary.)

SOUTH LOUISIANA

Iberville Parish: Texas Gulf Producing Co. 1 Schwing et al, 64-7s-9e. Dry. TD 10,237 ft.

Jefferson Davis Parish: H. L. Hunt 5 Lock-Moore, 9-8s-6w. Dry. TD 10,100 ft.

H. L. Hunt 2 Walker, 36-8s-6w. Dry. TD 12,327 ft.

Sunray Oil Corp. 1 Davies, 7-8s-5w. Dry. TD 10,735 ft.

Lafourche Parish: J. R. Frankel 1 Southdown, 111-14s-16e. IP 3,000 M.c.f. daily, estimated open flow, spray of condensate, perforations 11,890-98 ft. TD 12,329 ft. (New field.)

Plaquemines Parish: Shell Oil Co. 1 State Lease 1011, Block 24, South Pass area, Gulf of Mexico. IP 250 BOPD, 11164-in., 30°, perforations 7,430-40 ft. TD 9,918 ft. (New pay in and extends South Pass Block 24 field.)

St. Landry Parish: Fidelity Oil & Royalty Co. 1 Brown, 46 and 47-6s-2e. IP 113 BOPD, 7/64-in., 38°, perforations 8,847-55 ft. TD 9,525 ft. (New field.)

NORTH LOUISIANA

Concordia Parish: Crow Drilling Co.-T. L. James Co. 1 McGee, Evans, Bland Co., C SE NW 42-6n-9e. Dry. TD 7,010 ft.

DeSoto Parish: Midstates Oil Corp. 1 Olin Industries, Inc., 8-10n-14w. Dry. TD 8,003 ft.

Winn Parish: D. D. Jacob 1 Tremont Lumber Co., C NE SE SE 6-10n-1e. Dry. TD 1,469 ft. Outpost to Cross Roads field.

ARKANSAS

Arkansas County: Seaboard Oil Co. of Delaware 1 Bohnert, 31-7s-3w. Dry. TD 4,747 ft.

Lonoke County: J. T. Layton 1 Layton, C NE SE NW 17-2n-7w. Dry. TD 950 ft.

1 Layton Hole 2, C NE SE NW 17-2n-7w. Dry. TD 1,286 ft.

Ouachita County: Geo. Belchic, Jr. et al 1 Camden Coal & Clay Co., C NW NE SE 13-12s-18w. Dry. TD 1,756 ft.

OKLAHOMA

Carter County: C. E. Johnson 1 Woulfe, NW NW NW 15-3s-3w. Dry. TD 2,353 ft.

Garvin County: Wm. H. Pine 1 Medlock, SW SE NW 28-3n-3e. Dry. TD 2,382 ft.

Grant County: Continental Oil Co. 1 Connery, NE NE SW 32-28n-8w. Dry. TD 6,154 ft.

Greer County: Huval-Dunigan 1 Williams, NW NW SE 6-6n-20w. Dry. TD 1,284 ft.

Reco Oil Co. 1 Martin, NE NE NE 28-7n-21w. IPF 32 BOPD, quartz wash 1,227-30 ft., 37.9°, 12/64-in. TD 1,315 ft. (Oil discovery).

Jefferson County: Elmo Roy Batty 1 Echols, SW NW NW 11-5s-8w. Dry. TD 2,375 ft.

Kay County: O. H. Parker 1 Sprow, SE SW SW 4-26n-2e. Dry. TD 4,144 ft.

T. O. Lilystrand, Jr.-J. H. Leavell 1 McCluskey, NE NE SW 28-28n-5e. Dry. TD 3,062 ft.

W. B. Cleary, Inc. 1 Yockey, SE SE SW 34-29n-2e. Dry. TD 1,650 ft.

Kiowa County: Huffman & Malloy 1 Patten, NE SE SE 4-7n-15w. Dry. TD 7,015 ft.

Lincoln County: R. L. Kemp-Whan-Howard

~~MILLS PLASTIC~~ BUTYRATE III does jobs metal pipe can't do. Often cuts installation costs 50% and more

Mills Plastic III pipe weighs only about 1/10 as much as metal pipe of the same diameter, yet it takes on the toughest jobs. It speeds installations amazingly because it can be cut with an ordinary hand saw, and can be quickly joined with Milex fittings and Mills Plastic III Solvent. (The simple technique is shown at right. Flange adapter unions are available to adapt from S.W.P. sizing to iron pipe thread where required. Ask your distributor for details, or write for new booklet describing all Continental Mills Plastic piping, tubing and fittings.

PETROLEUM — Here's the ideal pipe for refinery discharge, crude oil, sour crude, salt water and natural gas.

UTILITIES — Easily installed in corroded gas lines by push- or pull-through methods. Eliminates trenching and repaving.

INDUSTRY — Successful where corrosive liquids or mineral depositions damage other pipe. Smooth walls increase flow rate.

AGRICULTURE — Installing stock watering lines, sprinkler systems and irrigation lines becomes a one-man job with Mills Plastic III.

1. Wipe pipe end with Mills Plastic III Solvent.

2. Wipe inside of fitting with Mills Plastic III Thinner.

3. Insert the pipe end into the prepared slip fitting.

4. The job's done. Pipe can be handled in minutes!

CONTINENTAL CAN COMPANY
MILLS PLASTIC PIPE DIVISION
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R/M SUPER-POWER V-BELTS...

Today's bigger rigs, higher rig floors and heavier power loads demand greater strength and more power delivery than ever in V-belt drives. R/M Super-Power V-Belts have that extra strength and power. With R/M Super-Power V-Belts you get 40% greater horsepower capacity than with regular V-belts. A combination of new synthetic fibers in the V-belt strength member provides greater resistance to heavy shock loads . . . virtually eliminates belt stretch and matching problems. R/M Super-Power construction, plus straight side-walls, means better belt tensioning and grip, less slip . . . more power delivered on the drive—*extra* power for your drilling and pumping operations. In addition, R/M Super-Power V-Belts are oil-proof, non-spark and heat resistant.

These features add up to "MORE USE PER DOLLAR" when you specify R/M Super-Power V-Belts for your drilling rigs and pumping units. Write for a copy of Bulletin 6628. And inquire also about other R/M V-Belt constructions, flat belts and rubber hose specially engineered by Manhattan for use in the oil field.

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Asbestos Textiles • Packings • Engineered Plastic, and Sintered Metal Products • Bowling Balls

RM-416

WILDCAT COMPLETIONS

Drilling Co. 1 Caves, SW SE SE 9-16n-6e. Dry. TD 3,637 ft.

Logan County: J. M. Shields 1 State, SE SW SE 36-16n-1e. Dry. TD 5,329 ft.

Noble County: Geo. P. Caulkins-M&M Drilling Co. 1 Potok, NW NW SE 26-21n-2w. Dry. TD 2,312 ft.

Roy G. Woods 1 Ehler, SE SE NE 15-24n-2e. Dry. TD 4,537 ft.

Nowata County: O. A. Bottom 1 Willis, SW SW NW SE 12-27n-15e. Dry. TD 1,145 ft.

Pawnee County: Signal Oil & Gas Corp. 1 Walenciak, C N½ SE NE 7-22n-5e. Dry. TD 4,072 ft.

Ketchum Oil Co. 1 Robbins, SE SE SW 12-23n-4e. Dry. TD 3,778 ft.

Pittsburg County: Magnolia Petroleum Co. 1 Manschrick, C SE NE 28-6n-17e. Dry. TD 12,915 ft. Arbuckle 12,336 ft.

Rogers County: Brewer & Bloom 1 Brewer, SE NE NE NW 17-22n-15e. IPF 140 BOPD, Burgess sand 1,007-32 ft. TD 1,032 ft. (Oil discovery).

Chas. Coleman 1 Shult, SE NW NE SW 6-24n-15e. Dry. TD 1,332 ft.

Stephens County: Mercury Drilling Co. 1 Rodolph, SE SE SE 29-2s-4w. Dry. TD 6,450 ft.

Woods County: Texas Crude 1 Schroeder, C NE SE 30-29n-19w. Dry. TD 5,684 ft. Miss. lime 5,560 ft.

NEBRASKA

Banner County: O'Donnell & Edmondson-Phillips Petroleum Co. 1 Brown, C SW SE 3-18n-54w. Dry. TD 5,443 ft. "J" sand.

1 Grant, C SW NE 20-19n-55w. Dry. TD 5,724 ft. "J" sand.

Cheyenne County: Lloyd R. Magneson 1 Pitman, SE NW NE 19-16n-49w. Dry. TD 4,766 ft.

Buck Wilson-Balderson-Denver 1 Green, NE NW NW 28-14n-49w. Dry. TD 4,818 ft.

KANSAS

Cowley County: Rex & Morris 1 Kielhorn, NE NE NW 29-31s-8e. Dry. TD 2,865 ft.

Dickinson County: Yingling et al 1 Wilson, SW SW SW 5-15s-1e. IPP 20 BOPD, Mississippian 2,571½-79 ft. TD 2,579 ft. (Opens Ash Grove pool.)

Graham County: Imperial Drilling Co. 1 Gick, C S½ NE SE 20-9s-23w. Dry. TD 4,382 ft.

Harper County: Aurora Gasoline Co. 1 Morris, SE SE SE 14-31s-9w. IPF 921 BOPD, Mississippian 4,398-4,404 ft., 37°. TD 4,500 ft. (Opens Grabs West pool.)

Musgrove Petroleum Co. 1 Moldenhauer, SW SW SW 27-32s-7w. IPF 3,000 BOPD, Simpson 4,833-39 ft. TD 5,024 ft. (Opens Banner pool.)

Marion County: Anderson-Prichard Oil Corp. 1 Youk, NE SW SW 20-18s-2e. Dry. TD 3,215 ft.

Norton County: Jones, Shelburne & Farmer 1 Gramzow, NE NE SW 10-1s-22w. Dry. TD 3,745 ft.

Empire Drilling Co. 1 Breeden estate, NE NE NW 13-5s-24w. Dry. TD 3,820 ft.

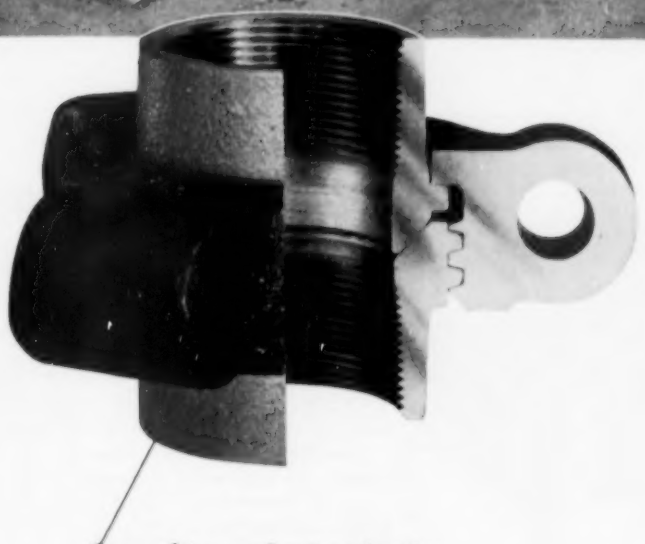
Pawnee County: Gulf Oil Corp. 1 Haege, NE NE NE 13-22s-17w. Dry. TD 4,155 ft.

Pratt County: Sterling et al 1 Elliott, NW SW SE 31-27s-13w. IPF 1,117 BOPD, Simpson 4,427-44 ft. TD 4,530 ft. (Oil discovery.)

Cooperative Refining Co. 1 Spines, NE NE NW 28-28s-14w. Dry. TD 4,677 ft.

Rush County: Great Lakes Carbon Corp. 1 Fitzpatrick, NW NW SE 2-16s-17w. Dry. TD 3,588 ft.

WECO FIG. 100 UNIONS



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and will give years of dependable,
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The Midget 1½" . . . Weight 63 lbs. . . . . 5,850 G.P.H.
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MANSFIELD, OHIO

WILDCAT COMPLETIONS

Saline County: Fick et al 1 Sailors, NE NW SW 14-14s-2w. Dry. TD 3,400 ft.
C. U. Bays-Shields 1 Johnson, NE NE SE 11-14s-4w. Dry. TD 3,805 ft.
Stafford County: Natural Gas & Oil Corp. 1 Smith, SE SE NW 30-23s-13w. Dry. TD 4,040 ft.
Cooperative Refining Co. 1 McMillan "A," SW NE NW 30-24s-11w. IPP 32 BOPD, Viola 3,908-13 ft. TD 4,098 ft. (Opens Mopac pool.)

SOUTH DAKOTA

Harding County: Amerada 1 Unit, C SE NW 19-16n-2e. Dry. TD 3,865 ft. Morrison.
Stanley County: Shamrock Oil & Gas Corp. 3 Barrick, SW SW 23-7n-26e. Dry. TD 4,070 ft. Granite.

NORTH DAKOTA

Benson County: Shell 1 Sinness, NE SW 2-156n-67w. Dry. TD 2,316 ft. Duperow.
McIntosh County: Calvert Exploration Co. 1 Nitschke, NE SE 13-130n-69w. Dry. TD 3,594 ft. Granite.
Sheridan County: Caroline Hunt Trust Estate 1 John Waltz, Jr., NE NE 15-148n-76w. Dry. TD 6,782 ft. Winnipeg.

CALIFORNIA

Sacramento County: Brazos Oil & Gas Co., Oper. 1 Brown-Graham Unit, 21-4n-4e. Dry. TD 3,841 ft.
San Joaquin County: W. W. Holmes, Oper. 1 Williams, 35-4n-5e. Dry. TD 4,415 ft.
Solano County: Shell Oil Co. 1 McCormack, 1-4n-1w. Dry. TD 5,300 ft.
Trico Oil & Gas Co. 2 Blacklock, 19-4n-1e. Dry. TD 5,564 ft.
Yolo County: Shell Oil Co. 4X-11 Kingsbury, 11-11n-3n. Dry. TD 5,500 ft.
Kern County: Carlton Beal & Assoc. 67-11 Kalloch, 11-25s-18e. Dry. TD 5,565 ft.
Moriqui Exploration Co. 17-26 Richards Bros., 26-29s-26e. Dry. TD 8,700 ft.
Atlas Oil Co. 2 Cauley, 16-30s-29e. Dry. TD 4,961 ft.
Tide Water Associated Oil Co. 34 P.M.O., 30-31s-23e. Dry. TD 3,165 ft.
Wilrich Development Co. 4 Gill, 25-26s-27e. Dry. TD 2,135 ft.
G. J. Green, Merle C. Wheeler and Alex Walton 1 Sycamore, 21-9n-17w. Dry. TD 320 ft.
General Oil Co. 34-4 Government, 4-30s-20e. Dry. TD 4,374 ft.
San Benito County: Richard C. Rheem, Oper. 1 Jacques, 20-12s-5e. Dry. TD 5,232 ft.
Ventura County: Pamoan Oil Co. 2 Flanagan, 5-2n-17w. Dry. TD 2,725 ft.
Los Angeles County: Union Oil Co. 7-A-4 Sansinena, 32-2s-10w. Dry. TD 5,574 ft.
Orange County: Shell Oil Co. 1 core hole, 16-3s-9w. Dry. TD 4,911 ft.
Atlantic Oil Co. 1 Sierra, 12-6s-9w. Dry. TD 3,500 ft.
Riverside County: Clifford A. Robinett 1 Pinkerton, 3-3s-7w. Dry. TD 1,068 ft.

MONTANA

Liberty County, South Chester area: Amerada Petroleum Corp. 2 Kolstad, SE SE 33-31n-4e. Dry. TD 2,345 ft. Madison.
Stillwater County, Big Coulee: Northern Natural Gas Producing Co. 1 NP, C NW SE 9-4n-20e. Dry. TD 3,131 ft. Swift.

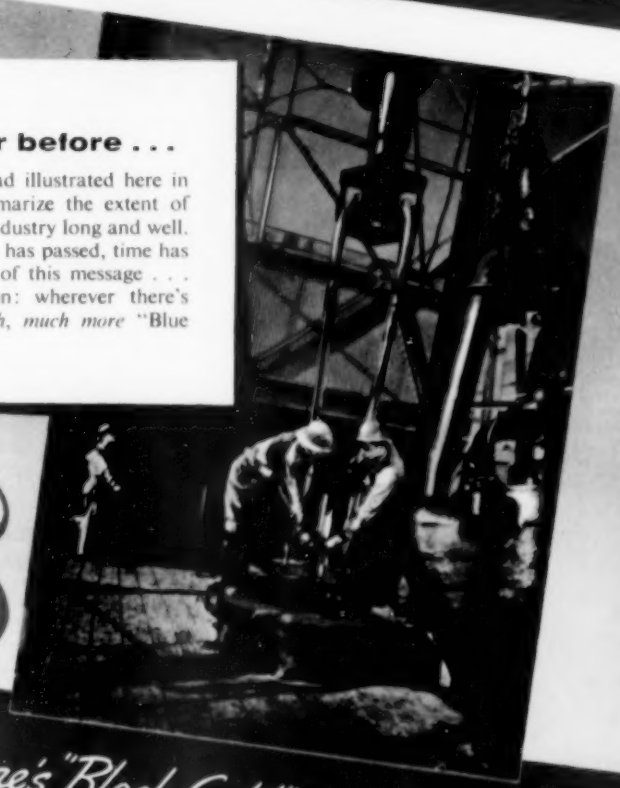
WYOMING

Johnson County: Byard Bennett 1 Beebe, C SW SW 24-43n-81w. Dry. TD 6,509 ft. Lakota.
Park County, Big Polecat: Mule Creek Oil Co. 1 Unit-State, E½ SE SW 16-57n-98w.

more than ever before . . .

Back in 1945, we ran the ad illustrated here in Fortune Magazine to summarize the extent of our efforts to serve the oil industry long and well.

Although nearly a decade has passed, time has not altered the correctness of this message . . . with one notable exception: wherever there's "Black Gold" there's *much, much more* "Blue Iron."



National Supply Products in The World of Today and Tomorrow

Wherever there's "Black Gold" there's "Blue Iron"

"Blue Iron" dots the landscape wherever oil men work around the world.

"Blue Iron" is the oil men's affectionate name for the NATIONAL Machinery and Equipment they use so widely and so well. *More oil country necessities are bought from NATIONAL than from any other single source.*

Massive "Blue Iron" blocks and swivels support as much as 300 tons of NATIONAL-made Spang Pipe, probing for oil four and five miles into the earth. NATIONAL-built Superior Gas, Oil and Diesel Engines supply the immense power needed for these big jobs.

NATIONAL Oil Field Products have served the oil industry for 50 years. Spang Pipe has a reputation of more than a hundred years for excellent service in every field where liquids, gases and electrical energy must be transported. Superior Engines serve industry on land and water, wherever steady, economical power is required.

All of these NATIONAL products have done exceptional wartime duty at home and abroad. Each has a definite, indispensable place in the world of today and tomorrow, to meet the rehabilitation, conversion and new planning needs which all commerce and industry face.

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Executive Offices: Pittsburgh, Pa.

Plants: At Toledo, Torrance, Calif., Houston; Carnegie, Pa., producing Oil Field Machinery and Equipment. At Ambridge, Pa.; and Bloomfield, Pa., producing Spang Seamless Pipe, Spang Oil Pipe, Spang Welded Pipe and Conival Rigid Steel Conduit. At Springfield, Ohio, producing Superior Gas, Oil and Diesel Engines. Export Sales: The National Supply Corporation, 30 Rockefeller Plaza, New York, N. Y.

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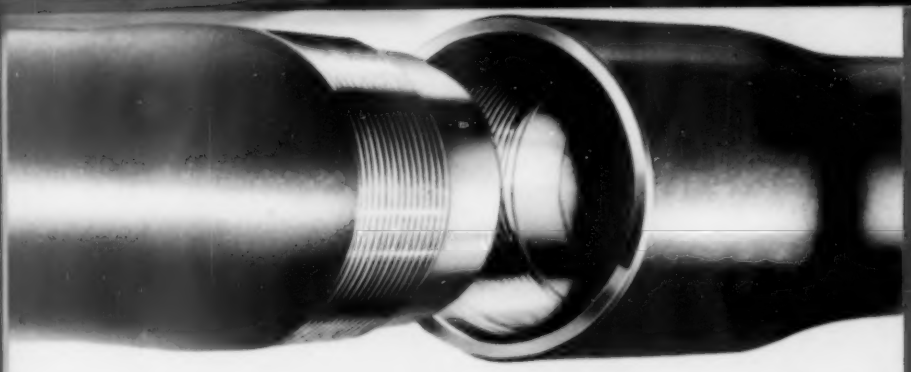
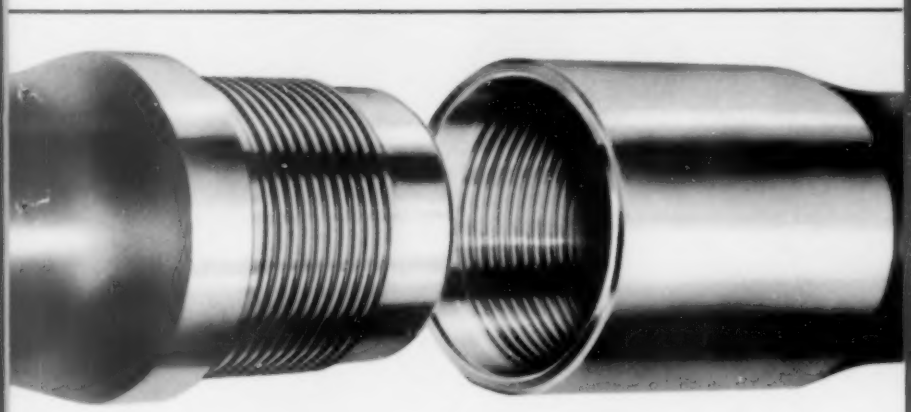
This exceptional quality of Spangseal and Spang Extreme Line Tubing in handling unusual well operating conditions is verified not only by Spang's continuous "extreme condition" plant tests . . . but by customers' performance reports, as well.

Three grades of Spang Extreme Line Tubing are now available to suit every well condition . . . Grades J-55, N-80 and P-105. Extreme Line Tubing sizes are furnished in standard weight, or wall thickness . . . and there's both intermediate and heavy wall thicknesses available in grades N-80 and P-105, for 2⅜" OD and 3½" OD tubing sizes.

You can get complete information on the Spang family of tubular products, which includes Spangweld Drill Pipe, Spang Double Seal Shrink Thread Drill Pipe and Spang Extreme Line Casing, from the local National Supply Representative or Store. Ask today for the latest bulletins on these top quality products.





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- Maximum Leakage Resistance
- More Hole Clearance
- Elimination of "Hanging-up"

SPANG EXTREME LINE Tubing

- Maximum Running Speed; Fast Joint Make-up
- 100% Joint Strength
- Streamlined
- Maximum Leakage-Resistance
- 50% Less Connections
- Positive Shoulder Contact Engagement

Corrosion Resistant Plastic Coating for Spang Tubing and Drill Pipe

To increase corrosion resistance, a phenolic plastic coating can be applied at the mill on all Spang Tubing and Drill Pipe. Ask the National Supply Representative about this Spang service.

NATIONAL BLUE PRODUCTS

First in quality...
First in supply service
in oil country everywhere

Spang-Chalfant Division
THE NATIONAL SUPPLY COMPANY
PITTSBURGH 30, PENNSYLVANIA

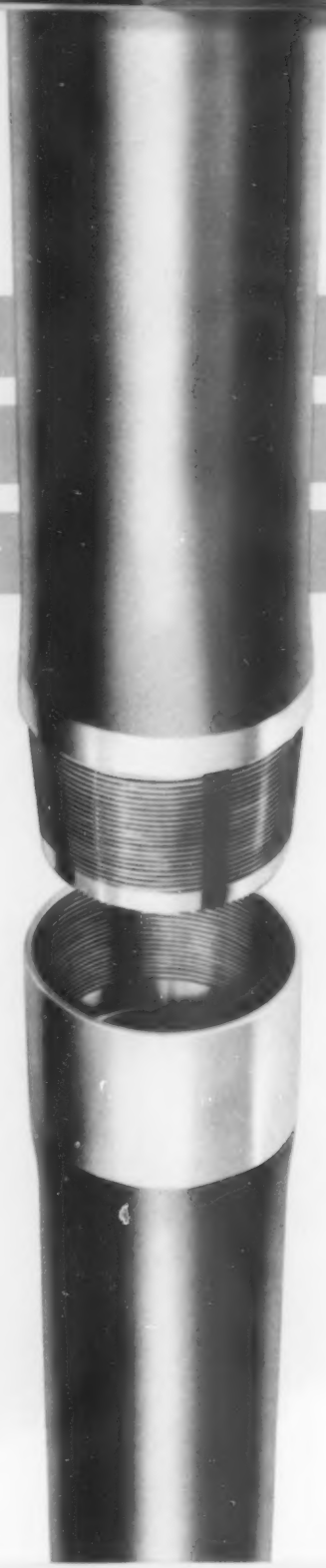
See the next page for information on another important Spang tubular product

Here's the quality casing for your toughest jobs . . .

GRADE J-55— 55,000 PSI MINIMUM YIELD STRENGTH

GRADE N-80— 80,000 PSI MINIMUM YIELD STRENGTH

GRADE P-110—110,000 PSI MINIMUM YIELD STRENGTH



SPANG®

EXTREME LINE® *Casing*

Operators everywhere rely on this quality, high-strength casing for their toughest jobs because it is:

Precision-manufactured—Spang Extreme Line Casing has the mechanical and metallurgical properties to withstand the high tensile loading, and to resist the extreme pressures found in present-day deep wells.

Streamlined—Interior and exterior contours provide for maximum running efficiency. There are no shoulders to hang-up on hole projections, or to scrape mud seal from the walls of the hole. This casing affords greater clearance than threaded and coupled casing when run inside a given diameter of outer string or open hole. Integral joint reduces the number of threaded connections by one-half.

Easy to handle—Very easy to stab, cannot be cross threaded, and positive shoulder contact engagement prevents overtonging. Only 5 to 7 turns with spinning line and less than one turn with the tongs are needed when running. Spang Extreme Line Casing can be salvaged and re-run repeatedly.

100% leak-resistant—This positive resistance to leakage is of primary importance in the choice of high strength casing for deep, high-pressure wells. The rugged integral joints of Spang Extreme Line Casing are your assurance of complete leakage resistance under the most severe and variable conditions you can encounter.

Whatever your tubular requirements, there's a variety of Spang Drill Pipe, Spang Tubing or Spang Casing to meet the needs of your well. Be sure to get all of the facts on how these Spang products really "pay-off" at the well by talking to the nearest Division Office listed below.

First in quality...
First in supply service
in oil country everywhere

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Spang-Chalfant Division

THE NATIONAL SUPPLY COMPANY

PITTSBURGH 30, PENNSYLVANIA

DIVISION TUBULAR OFFICES: Denver, Colorado; Houston, Texas; Fort Worth, Texas; Los Angeles, California; Pittsburgh, Pennsylvania; Tulsa, Oklahoma; Calgary, Alberta, Canada

NATIONAL OIL FIELD MACHINERY AND EQUIPMENT
SPANG STEEL PIPE • SUPERIOR & ATLAS ENGINES

WILDCAT COMPLETIONS

IPP 374 BOPD, Tensleep discovery, new pay. TD 5,572 ft. Amsden.

COLORADO

Larimer County: A. W. Quinlan 1 Wessel, SW NW SE 21-9n-69w. Dry. TD 900 ft. Temp. abd.

Brush Oil Development 1 Thompson, NW SW SW 12-4n-70w. Dry. TD 645 ft.

Ed Lesh 1 Swanson, C SE NW 7-11n-69w. Dry. TD 755 ft.

Logan County: Falcon Seaboard Drilling Co. 1 Norcott, NE SE SE 24-11n-55w. Dry. TD 5,550 ft.

Malco Refineries - Balderson - Denver 1 Sprague-Peavy, C SW SE 5-11n-55w. Dry. TD 5,820 ft.

O'Donnell & Edmondson-Stanolind Oil & Gas Co. 1 French, C NW NW 11-6n-53w. Dry. TD 4,740 ft.

Moffat County, Slater Dome: Quintana Production Co. 1 C. F. & I. Corp., NE SE SW 13-12n-89w. IP 1,500 M.c.f. of gas per day, estimated. Mesaverde discovery, new field. TD 8,525 ft. Entrada.

Morgan County: Bruce Sullivan-J. Taylor 1 Sagel, SE SE SE 4-3n-58w. Dry. TD 5,920 ft.

Frank G. Weimer-John R. Fitzhugh 1 Graham, SW SE NW 12-3n-57w. Dry. TD 5,562 ft.

Equity Oil Co. 2 Casper-Weber, SE NW NE 30-1n-58w. Dry. TD 6,166 ft.

S. D. Johnson 1 Ault, SW SW SE 10-3n-58w. Dry. TD 5,889 ft.

1 Amen, SW SW NW 13-3n-58w. Dry. TD 5,827 ft.

1 Lage, SE SE NW 24-3n-58w. Dry. TD 5,783 ft.

J. A. McRae 2 Peterson, SW SW NW 9-1n-55w. Dry. TD 5,137 ft.

Washington County: O'Donnell & Edmondson 1 Kral, NW NW SE 10-1s-55w. Dry. TD 5,067 ft.

Jack Rouse 1 Jueske, C NE NE 18-4n-50w. Dry. TD 4,392 ft.

Shell Oil Co. 1 Hiccock, NW SE NE 19-2s-54w. Dry. TD 4,937 ft.

Sinclair Oil & Gas Co. 1 Larsen, NW NW NE 8-1s-55w. Dry. TD 5,107 ft.

Weld County: Harry Royster-Lohmann-Johnson 2 Littler, C SE SE 35-4n-62w. Dry. TD 6,682 ft.

S. D. Johnson 1-24 State-Weiss, C NW SE 24-4n-62w. Dry. TD 6,580 ft.

SASKATCHEWAN

Imperial 14-24-10-6 Warmley, LSD 14, 24-10-6w2. Dry. TD 4,900 ft.

Tide Water 1 Beckenham Crown, LSD 4, 13-27-11w2. Dry. TD 2,435 ft.

Tide Water 5-17 Loomis Crown, LSD 5, 17-3-21w3. Dry. TD 4,870 ft.

British American-Cooperative Calvan 12-10 Cypress Lake, LSD 12, 10-5-26w3. Dry. TD 4,790 ft.

Tide Water 2 Abbey Crown, LSD 1, 31-21-18w3. Dry. TD 2,676 ft.

ALBERTA

Evans-Union 13-10 Warner, LSD 13, 10-5-16w4. Dry. TD 3,327 ft.

Canadian-Gas Export 10-34 Irvine, LSD 10, 34-11-2w4. Medicine Hat gas well. TD 1,530 ft.

High Crest et al 7-23 Atlee, LSD 7, 23-22-7w4. Dry. TD 2,901 ft.

Socony 26-14 North Carbon, LSD 14, 26-29-23w4. Dry. TD 6,561 ft.

Imperial 6-32-36-5 Provost, LSD 6, 32-26-5w4. Viking gas well. TD 2,721 ft.

Union-Imperial 14-8 North Fairydell, LSD 14, 8-58-24w4. Dry. TD 3,940 ft.

Imperial-Canadian Superior 4-22-45-5 Pendryl, LSD 4, 22-45-5w5. Dry. TD 10,363 ft.

MANITOBA

British American-Union 4-13 Croll, LSD 4, 13-4-21w1l. Dry. TD 2,745 ft.

Sweetgrass 1 Alta Mont, LSD 2, 35-5-8w1. Dry. TD 2,532 ft.

Dome-Harris-Cox 2-32A West Lenore, LSD 2, 32-11-25w1. Dry. TD 2,143 ft.

Dome-Harris-Cox 12-28 Miniota, LSD 12, 28-13-26w1. Dry. TD 2,103 ft.

LEGAL

SEALED BIDS will be received until 2.00 P. M., Mountain Standard Time, October 5, 1954, and opened at that time in the Office of the Fort Peck Indian Agency, Poplar, Montana, for the leasing of 14,387.41 acres of Tribal land and 37,485.37 acres of allotted Indian land, located in Roosevelt and Valley Counties, Montana, for oil and gas mining purposes. The details of the lease offering and how and where to file bids may be obtained by addressing the inquiry to the Superintendent of the Fort Peck Indian Agency, at Poplar, Montana, or telephone, Poplar, 2181.

LEGAL

U. S. DEPARTMENT OF INTERIOR, Bureau of Land Management, Washington 25, D. C. Notice is hereby given that 192.73 acres of land within the known geologic structure of the Hell's Hole Canyon Field in Rio Blanco County, Colorado, will be offered for oil and gas leasing through competitive bidding to the qualified bidder of the highest cash amount per acre at 1:00 p.m., E.S.T., September 29, 1954, when bids will be opened. Details of the lease offering, description of the lands, how and where to submit bids, and bid forms may be obtained from the Manager of the Land Office, Denver, Colorado, or from the Director, Bureau of Land Management, Washington 25, D. C. L. E. Hoffman, Minerals Officer.

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THE OIL AND GAS JOURNAL

"Anything wrong, Elmer?"

Wright On Up

Carter executive assumes key Jersey production job

M A. (MIKE) WRIGHT, the new coordinator of production for Standard Oil Co. (N.J.), has made a big jump in 21 years—from a pipeline bunkhouse in Seminole, Okla., to an executive suite in Rockefeller Plaza.

Wright was named to the Jersey post last week. It is one of several key advancements he has received in recent years. He takes over his new job after serving 2 years as executive vice president and a director of Carter Oil Co., Tulsa, a Jersey affiliate. His promotion may be a stepping stone to even bigger things. At least, that's been the pattern for several years.

Back in 1933 when he was living in the Seminole bunkhouse, Wright was working as a roustabout for a Carter pipeline gang. He had recently joined Carter fresh out of Oklahoma A. & M. College with a civil engineering degree. He chose the Carter job in preference to becoming a county engineer. It proved a wise decision.

'Small town' boy . . . The 43-year-old executive is a product of several small Oklahoma communities. He was born at Blair, in southwestern Oklahoma, later moving to Altus, El Reno, and Shattuck. When he was about 11 his father bought a drug store in Waynoka. During his teens, he worked as a newspaper carrier, janitor, ticket taker at Waynoka's only movie house, and occasionally as a soda jerk in his father's store. Scholastically, he was a whiz in high school, graduating as valedictorian of his class.

Wright and his wife, Izetta, grew up together in Waynoka. Now they feel they are permanent residents of a community if they live anywhere more than 2 years. Since their marriage in 1935, they have moved eight times. The couple has one daughter, Judith, who is 9 years old.

His first 2 years of college were at Northwestern State College, Alva, Okla. He earned expense money playing a trumpet in a dance orchestra. During his summer vacations he worked 1 year for the Santa Fe Railway and 2 years as a federal wheat inspector at Waynoka.

Talents spotted . . . When Wright assumed his duties as executive vice president of Carter in 1952, it didn't take the Tulsa Chamber of Commerce long to recognize his talents. Within a few months he was appointed to the board of directors and last year was elected first vice president. He was moving up fast.

He also was active in Community Chest work, serving as co-chairman of the executive division last year. Oklahoma A. & M. also called on his talents, placing him on the Alumni Advisory Board the past 2 years.

But, the Jersey management in New York long had been cognizant of able Mike Wright, as his company record shows.

He worked for Carter in several Oklahoma fields until 1941, when he started climbing up the ladder that led to his Rockfeller office. He was transferred to Shreveport as southern division engineer in 1941 and 2 years later was named chief petroleum engineer in Tulsa. He became assistant manager of the production department 10 months after going to Tulsa.

Solid background . . . Wright has a solid background in the workings of the department he will head. He was promoted to the department in 1946 and was shifted from desk to desk learning how Jersey conducts its world-wide program. He worked up to deputy coordinator in 1949, but was on the move again in 2 more years. His next assignment was as executive vice president of International Petroleum Co., Ltd., a Jersey affiliate headquartering in Coral Gables, Fla. He was in Florida about a year before returning to Carter in Tulsa.

In his new post, he will fill the vacancy left by the recent death of Roger H. Sherman.

As a hobby, Wright plays tennis. During his days at Oklahoma A. & M. he was captain of the tennis team. But, his game has become a little rusty as his responsibility with Jersey grows. His new appointment is probably a bad omen for his tennis.

Joseph L. Seger, vice president and director of Carter Oil Co., has been elected executive vice president to succeed **M. A. Wright** (see above). **C. C. Herrington,** a Carter director, has been elevated to vice president. Seger, a veteran of 21 years with the Standard Oil Co. (N. J.) organization, returned to Carter in June of this year after serving more than 2 years as president of Interstate Oil Pipe Line Co. Seger received a B.A. degree from the University of Illinois in 1927 and 2 years later received an LL.B. degree from Yale Law School. He joined Carter's legal department in 1933 and 11 years later was named secretary of the company. He was named general counsel of Interstate in 1946, moving up to the presidency in 1951. Seger also is a director of Interstate and of Yellowstone Pipe Line Co. Herrington has been with Carter since his graduation from Oklahoma A. & M. College in 1934. He was named Carter's chief engineer in 1944 and manager of the production department in 1948. He was made a director in 1952.

Ted C. Bodley, former senior vice president and secretary of Suntide Refining Co., has organized Mohawk Petroleum Co., Tulsa, a firm that will buy and transport crude oil. Bodley is president of Mohawk. The new firm will operate a fleet of tank trucks in Oklahoma to serve production without pipeline connections. Bodley, a graduate of the University of Tulsa, started his oil career in 1939 with Mid-Continent Pipe Line Co. Twelve years later, he joined Sunray Oil Corp., working up to vice president and manager of Sunray Coastal Pipe Line Co. He joined Suntide in 1952, helping direct construction of the company's Corpus Christi refinery.

Martin F. Casey has been elected executive vice president of Forest Oil Corp. by the board of directors of the company.

PERSONALS

Garner L. Wilde, Humble Oil & Refining Co., Midland, Tex., has been named chairman of the steering committee of Permian basin section of the Society of Economic Paleontologists and Mineralogists. Other members of the steering committee include: **Wayne Roye,** Magnolia Petroleum Co., Midland; **Tom Schneider,** Texas Pacific Coal & Oil Co., Midland; **E. A. Vogler,** Shell Oil Co., Midland; and **Harold L. Williams,** Paleontologist Laboratory, Midland.

Hayden Hughes, who joined Mid-Continent Petroleum Corp. September 1, has been named assistant to the vice president of production. Hughes has been active in the petroleum industry since his graduation in 1932 from the University of Oklahoma. During World War II, he served a year with the Petroleum Administration for War. Since 1945, he has worked primarily in South America. One of his last assignments was with International Petroleum, Ltd., in charge of exploration, production, and refining in Colombia.

Don Hall has been promoted from assistant chief geologist to chief geologist by Hill & Hill, Fort Worth independent. Hall joined Hill & Hill as a geologist in 1949 after working 4 years as a geologist for Sinclair Oil & Gas Co. in Wichita Falls, Tex., and Fort Worth.

H. S. McCRAY

Howard S. McCray, superintendent of The Texas Co.'s Lockport, Ill., refinery, has been named manager of operations of Texaco's refining department. **Eddins W. McNealy,** superintendent of the Eagle Point refinery, Westville, N. J., has been moved to McCray's old post and **Robert H. Aitken** has been elevated from assistant to superintendent at Eagle Point. **Horace H. Chandler,** former assistant superintendent of manufacturing at Port Arthur, Tex., will become Aitken's assistant. McCray joined Texaco in 1926 after graduating from Pennsylvania State College. He has served as superintendent of the Sunburst, Mont., Amarillo, and Lawrenceville, Ill., refineries. In other refining department changes, **E. L. Droddy** has been elevated from assistant to general manager at New York, and **W. R. Sorenson** and **R. E. Manley** have been named assistant supervisors in the process division. At Port Arthur, **C. E. Lauer** has been named superintendent of product control, **Charles Richker,** chief process engineer, and **W. M. Abbey,** chief chemist.

James E. McCormick, geologist, has been transferred by Sun Oil Co. from its Gulf Coast division office at Beaumont to the district office at Houston.

C. J. HEDLUND

C. J. Hedlund has been elected to the board of directors of Esso Shipping Co. He is manager of the coordination and petroleum economics department of Standard Oil Co. (N. J.) Hedlund succeeds **J. A. Cogan,** who recently joined Imperial Oil Ltd., Jersey's Canadian affiliate. The new director has been associated with the Jersey organization since 1940

S. W. Dedman, Jr., has been promoted to senior mechanical engineer in the engineering division of the Baytown refinery by Humble Oil & Refining Co. Dedman joined Humble after graduating from Texas A. & M. College in 1947.

W. G. Whisnand has joined British-American Oil Producing Co. as a geologist in the firm's Midland, Tex., office. Prior to joining British-American, he worked as a geologist for Texas Gulf Producing Co. and Gulf Oil Corp.

P. Gordon has been appointed manager of the process department at the head office by Shell Oil Co. of Canada, Ltd. Other Shell Canada advancements include: **E. A. Ballman** appointed assistant manager of Shellburn, Burnaby, B. C., refinery; **E. S. Chung** named assistant manager of technological department at the Montreal refinery; **A. V. Doyle** promoted to assistant manager of catalytic cracking, light ends, at Montreal refinery; **J. C. Fisher** appointed technologist in the catalytic cracking section of Montreal refinery; **A. J. Foote** named manager of technological department at Montreal refinery; **J. E. Nichol** promoted to manager of catalytic cracking section at Montreal refinery; **J. E. Simkins** appointed technologist of the topping and thermal cracking section at Montreal refinery, and **L. H. C. Reynolds** named assistant superintendent at the Montreal chemical plant.

D. M. West, district geologist for Socony-Vacuum Oil Co. of Canada, Ltd., at Regina since 1952, has been transferred to the company's Alberta district as district geologist. **A. R. Nielson,** former district geologist at Edmonton, will succeed West at Regina.

William T. Stokes, Jr., has been appointed exploration manager in the West Texas-New Mexico area for Bright & Schiff, Dallas, and has been transferred from San Antonio to Midland. **John A. Myers,** production superintendent at Midland, has moved to the Dallas office while **Hugh Meyer,** who recently returned from the armed forces, has joined the Midland office as a petroleum engineer.

Fred Powell and **J. E. Gosline** have been appointed departmental general managers by Standard Oil Co. of Cali-

FRED POWELL

J. E. GOSLINE

fornia. Powell, president of the former California Research & Development Corp., a Standard subsidiary, has been named manager of the manufacturing department. He succeeds **O. N. Miller,** now a vice president. Powell has been with Standard since 1925 and at one time was manager of the El Segundo refinery. Gosline is the new head of the producing department which previously operated under vice president **J. E. Toussaint.** Gosline formerly was assistant general manager of the department. Once head of the company's southern division, he has been with the company since 1933.

D. W. Ratliff has been named to head the new geophysical offices at Jackson, Miss., recently opened by Stanolind Oil & Gas Co. Ratliff, who is now head of the Oklahoma City geophysical office for Stanolind, will continue to head that office also and to make his headquarters at Oklahoma City.

H. E. Treichler, Jr., has been promoted to assistant to the president of Houston Oil Co. of Texas. Treichler has been succeeded as superintendent of drilling and production by **Barrett E.**

PERSONALS

Booth, former superintendent of the company's southwestern district at Beeville, Tex. **Ralph W. Brown,** former drilling foreman, has been boosted to Booth's post at Beeville.

J. S. Mathis has been named district superintendent at Maxie, Miss., by Ohio Oil Co. He formerly was Ohio's superintendent at Hattiesburg, Miss.

L. B. DORSEY

Leon B. Dorsey has been promoted to superintendent of gasoline plants by Southern Production Co., Inc., Fort Worth. Dorsey will coordinate all gasoline-plant activities of the company. He takes the new job after serving as superintendent of Southern Production's Pledger gasoline plant near West Columbia, Tex. **M. V. Dunk,** assistant superintendent at Pledger, will succeed Dorsey as superintendent.

H. D. Fox has been promoted to chief geologist of Canada for Sohio Petroleum Co., replacing **Dr. Rein de Wit,** who has been transferred to become staff geologist of the northwest division, Calgary.

Marshall R. Joy, manager of Brazos Oil & Gas Co., Mount Pleasant, Mich., has joined Frankfort Oil Co., Bartlesville, as manager of production. Joy was associated with Cities Service Oil Co. 20 years when he resigned in 1946 to become manager of production for Toklan Production Co. at Tulsa. He left Toklan to join Brazos.

H. T. Chilton, executive assistant to the vice president of operations, Service Pipe Line Co., has been named consultant to the Joint Construction Agency of United States European Command. His principal job will be to advise military leaders on construction of a products line being laid from the Atlantic port of St. Nazaire to Metz. Chilton leaves for Paris September 20. He will relieve **C. B. Lester,** chief engineer of Mid-Valley Pipeline Co. Chilton, a University of Texas graduate, has been with Service since 1947.

H. T. CHILTON

C. B. Schwartz is manager of the new exploration and production office of Rock Island Refining Corp. at Denver. The Denver office replaces an office closed at Fort Worth. Schwartz was production head at the Fort Worth office.

R. D. Martin, Chicago, manager of crude-oil coordination for Standard Oil Co. (Ind.), has been appointed manager of the coordinating department of Stanolind Oil Purchasing Co., Tulsa. He will be succeeded at Chicago by **W. A. Kirkpatrick,** manager of Stanolind Purchasing's oil coordinating department.

A. N. Lucie-Smith has joined the Australian consulting firm of Mines Administration Pty., Ltd., as general manager. Lucie-Smith formerly was head of the production department in eastern Venezuela for Cia. Shell de Venezuela. He is scheduled to arrive in Australia in October to assume his new duties.

Joe J. Marty and **Dr. James K. Rogers** have received new appointments in the San Antonio office of Arkansas

JOE J. MARTY

DR. J. K. ROGERS

Fuel Oil Corp. Marty has been named division exploration manager and Dr. Rogers regional research geologist. Marty has been with Arkansas Fuel since 1937, serving as a draftsman, geological scout, and landman in the San Antonio office. Dr. Rogers also joined the firm in 1937. He is a former district geologist and division geologist in the San Antonio office.

Dr. J. W. Bertetti, general manager of manufacturing for Pan-Am Southern Corp., has been elected to the board of directors of the company. Bertetti succeeds **M. C. Hoffman,** who has transferred to an executive post with Stanolind Oil & Gas Co. Bertetti joined Standard Oil Co. (Ind.) in 1934 and in 1936 was transferred to Pan American Petroleum & Transport Co., a Standard of Indiana subsidiary. He later joined Root Petroleum Co. and when it was merged with Pan American Petroleum Corp. he joined Pan-Am Southern, the company formed by the merger.

H. K. Apel has been promoted from assistant to manager of the gasoline and refined oils department at Chicago of Standard Oil Co. (Ind.). He succeeds **H. J. Bemis,** who is retiring after 43 years with the company. Apel has been associated with Standard since 1914. During his years with the company, Bemis served at Hibbing, Minn., St. Louis, Milwaukee, Sioux City, Ia., St. Joseph, Mo., Davenport, Ia., and Chicago.

DEATHS

John S. Archer, 58, superintendent of the Gray Wolfe Co., died at Houston. Archer had been associated with Gray Wolfe 32 years.

Clarence F. Knollenberg, 63, production superintendent for Sun Oil Co. in Michigan, died September 12 in the Mount Pleasant, Mich., hospital. Knollenberg had been affiliated with Sun throughout his business career, joining the organization in 1919 at Tulsa.

Martin C. Madsen, 61, chief engineer for Northern Natural Gas Co., died recently in Omaha. His oil career dated back to 1913, and included design of numerous facilities, including gasoline plants, refineries, compressor stations, pump stations, and ships. He joined Northern Natural in 1944 after designing and directing construction of Natural Gas Pipeline Co. of America's compressor stations on the original pipeline system between Fritch, Tex., and Chicago.

Harry Bess, 85, died recently in Long Beach, Calif. Bess has been active in the industry 65 years and at time was president of Rainbow Petroleum Co. He also had been associated with B. & H. Oil Co. and Bash Voorhis Oil Co.

Forest Goody, 42, Long Beach drilling contractor, died in Los Angeles.

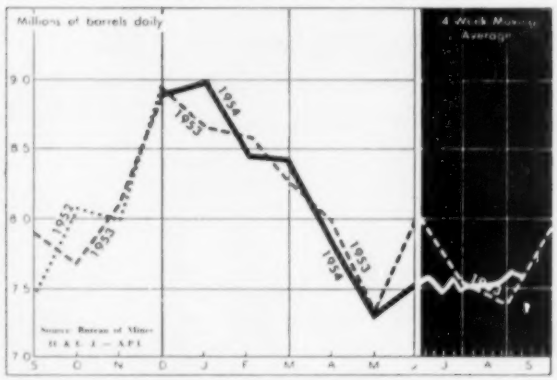
B. H. Allison, 67, Drumright, Okla., died recently at his home near Drumright. Allison retired in 1952 as district production superintendent at Drumright for Mid-Continent Petroleum Corp. He had been with the firm 35 years. At the time of his death, he was production superintendent for O. F. Warren, Tulsa independent.

Latest Figures . . . Industry Trends

A QUICK LOOK AT THE HIGHLIGHTS

	LATEST WEEK	Change from WEEK AGO		Change from YEAR AGO	
Production	6,174,800	UP	40,450	DOWN	399,897
Crude stocks	274,837,000	DOWN	1,648,000	DOWN	6,390,000
Completions	1,081	UP	2	UP	83
Refinery runs	6,989,000	UP	43,000	DOWN	227,000
Gasoline stocks	153,279,000	DOWN	218,000	UP	11,791,000
Four-product stocks	368,455,000	UP	5,942,000	UP	13,628,000
Total imports	1,038,000	DOWN	27,100	UP	92,100

TOTAL DEMAND – ALL OILS



Between-Season Lull in Demand Prevents Improvement in Markets

TOTAL demand for all products averaged about 7,342,000 bbl. daily for week ended September 10 and a little less than 7,600,000 bbl. daily for the 4-week period. The average for the week was the lowest since the first week of June.

Some suppliers had expected a spurt in gasoline demand during the week, based on the need for jobbers to refill tanks after the Labor Day week end. However the indicated demand for the week was less than the average for August. August demand for gasoline, calculated from weekly data, averaged about 3,650,000 bbl. daily. Figures for the week ended September 10 show a demand of about 3,570,000 bbl. daily for that week.

Middle-distillate demand for the week is estimated at about 1,020,000 bbl. daily or 150,000 bbl. daily less than the August average.

Late September gains . . . Heating-oil demand is expected to increase in the last half of September. In a few cases summer discounts will run only to the end of September, and cooler weather will tend to boost sales near the end of the month.

Gasoline demand in September 1953 was better than in August, but if the latest week's figures are any indication of the trend this year, demand in September will be much less than in August.

Gasoline stocks have decreased less than 500,000 bbl. in the past 2 weeks and have dropped only 5,500,000 bbl. in the past 5 weeks. If this trend continues, gasoline inventories will not go below 150,000,000 bbl. this fall. An end-of-the-season level of about 130,000,000 bbl. was considered "about right" by some suppliers.

Gasoline markets . . . The poor record in stock reductions is showing up as soft gasoline markets, particularly in the Mid-Continent and North Central States.

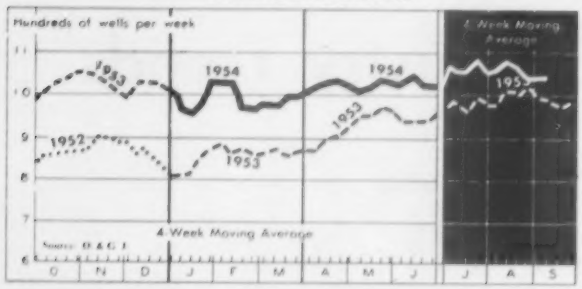
Gasoline inventories in District 2 are 6,715,000 bbl. higher than last year, representing about 57 per cent of the total gain in gasoline stocks.

Gasoline prices are under greater pressure in the Group 3 area than in other districts. Some suppliers are still reporting formal quotations of 10.75 cents a gallon plus pipeline charges for regular gasoline delivered at northern pipeline terminals. However, there have been no recent reports of spot sales at this high quotation.

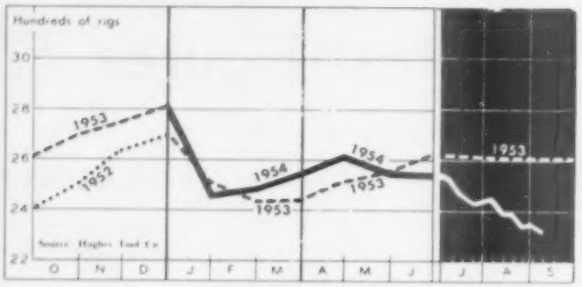
Spot sales to resellers have been reported as low as 9.875 cents a gallon with movement to jobbers at 10 cents. In some cases the low prices were on distress material, some of which had to move because of demurrage charges. However, not all of the recent movement at low prices can be classified as temporarily distressed material, and no reports have been received of Group 3 spot sales at prices above 10.25 cents a gallon plus pipeline charges.

Higher tanker rates . . . Increased tanker rates have boosted cost of distillate fuel delivered on the East Coast. Recent quotations of cargo prices for No. 2 fuel in New York Harbor have been about 8.65 cents a gallon. Higher tanker rates plus 8.25 cents at the Gulf Coast have raised this East Coast cost to about 8.95 cents a gallon.

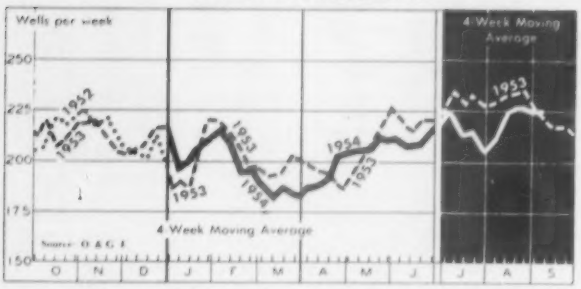
TOTAL COMPLETIONS



ROTARY RIGS OPERATING IN UNITED STATES



WILDCAT COMPLETIONS



ACTIVE ROTARY RIGS

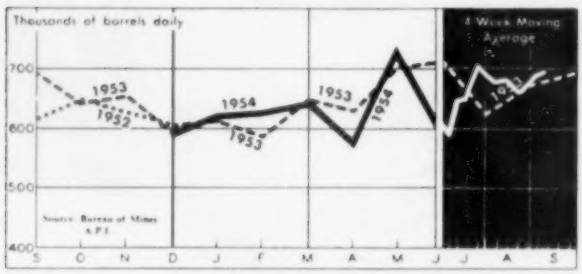
Area—	9-13-54	Change from 9-6-54	Change from 9-14-53
Gulf Coast	478		— 23
N. and W. Texas-New Mexico	718	— 7	— 72
Arkansas-N. Louisiana-E. Texas	187	14	8
Oklahoma	281	— 5	— 70
Kansas-S. Nebraska	154	— 5	
Illinois-Eastern	147	—14	— 1
Rocky Mountain	231	—14	— 44
Pacific Coast	127	2	— 46
Total United States	2,323	—29	—248
Western Canada	116	— 2	— 61

WEEKLY WELL COMPLETIONS . . . WEEK ENDED SEPTEMBER 11, 1954

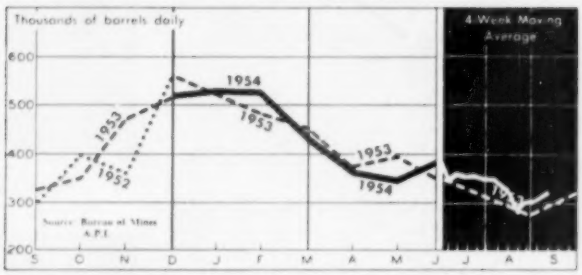
	Total of all wells: Comp.	Oil	Gas	Dry	Footage	Cum. 1954	Cum. 1953	Wildcat completions and discoveries: Oil	Dist.	Gas	Dry	Total	Cumulative total, 1954: Oil	Dist.	Gas	Dry	Total
Ala.-Ga.-Fla.	2	0	0	2	11,296	79	101	0	0	0	2	2	2	0	2	68	72
Arkansas	10	4	0	6	25,884	439	363	0	0	0	4	4	19	0	4	83	106
California	51	31	1	19	215,080	1,664	1,805	0	0	0	19	19	42	1	9	367	419
Colorado	29	5	1	23	144,252	917	478	0	0	1	19	20	25	0	14	368	407
Illinois	40	21	0	19	104,610	1,936	1,311	0	0	0	0	0	8	0	0	233	241
Indiana	13	6	2	5	21,090	549	904	0	0	0	0	0	7	0	0	96	103
Kansas	87	52	3	*32	300,024	3,194	3,441	5	0	0	11	16	57	0	15	422	494
Kentucky	22	5	7	10	47,154	775	767	1	0	0	2	3	13	0	3	79	95
Louisiana	68	38	5	25	409,339	2,442	1,822	2	1	0	7	10	78	41	27	241	387
North	34	19	3	12	127,279	1,331	761	0	0	0	3	3	11	3	11	96	121
South	34	19	2	13	282,060	1,111	1,061	2	1	0	4	7	67	38	16	145	266
Michigan	9	3	0	6	21,299	390	413	0	0	0	4	4	13	0	0	145	158
Mississippi	9	5	0	4	55,278	286	259	1	0	0	1	2	8	1	0	100	109
Montana	9	4	1	4	26,854	217	287	0	0	0	2	2	3	0	1	67	71
Nebraska	25	17	0	8	143,375	295	234	0	0	0	4	4	17	0	3	90	110
New Mexico	37	9	22	6	156,252	770	978	0	0	1	3	4	13	0	15	81	109
North Dakota	5	2	0	3	29,903	206	180	0	0	0	3	3	4	0	0	77	81
Ohio	26	8	6	12	52,271	805	744	0	0	0	0	0	3	0	4	11	18
Oklahoma	188	113	10	†65	543,625	6,440	5,178	2	0	0	20	22	83	3	18	464	568
Pennsylvania-New York	43	14	14	‡15	74,256	1,651	1,801	0	0	0	0	0	0	0	5	28	33
Texas	374	221	15	138	1,688,100	13,020	12,037	11	3	2	96	112	578	54	125	2,978	3,735
Southwest (1 & 7)	54	31	4	19	221,003	1,865	1,948	3	1	0	12	16	81	24	33	513	651
Gulf Coast (2 & 3)	46	27	0	19	311,853	1,881	1,769	3	2	0	13	18	61	25	38	471	595
East (5 & 6)	20	8	3	9	107,228	676	556	1	0	0	9	10	12	0	13	205	230
North Central (7-B & 9)	127	65	0	62	388,999	4,863	4,567	1	0	0	42	43	263	4	16	1,197	1,480
West (7-C & 8)	94	65	2	27	547,544	3,023	2,636	3	0	1	20	24	159	0	17	527	703
Panhandle (10)	33	25	6	2	111,473	712	561	0	0	1	0	1	2	1	8	65	76
Utah	0	0	0	0	0	51	50	0	0	0	0	0	3	0	1	27	31
West Virginia	15	0	13	2	40,528	411	428	0	0	0	1	1	0	0	20	13	33
Wyoming	17	9	4	§4	73,863	915	499	1	0	0	1	2	29	0	6	136	171
Miscellaneous (S. D.)	2	0	0	2	7,935	92	56	0	0	0	2	2	2	0	0	24	26
Total United States	**1,081**	567	104	410	4,192,268	37,544	34,136	23	4	4	201	**232**	1,007	100	272	6,198	7,577
Total previous week	1,079	579	91	389	4,378,046			31	3	5	176	215	984	96	268	5,997	7,345
Total September 12, 1953	996	497	82	417	3,822,691			25	0	7	185	217	1,024	73	270	6,372	7,739

Service wells included: *1, †14, ‡13, §3.

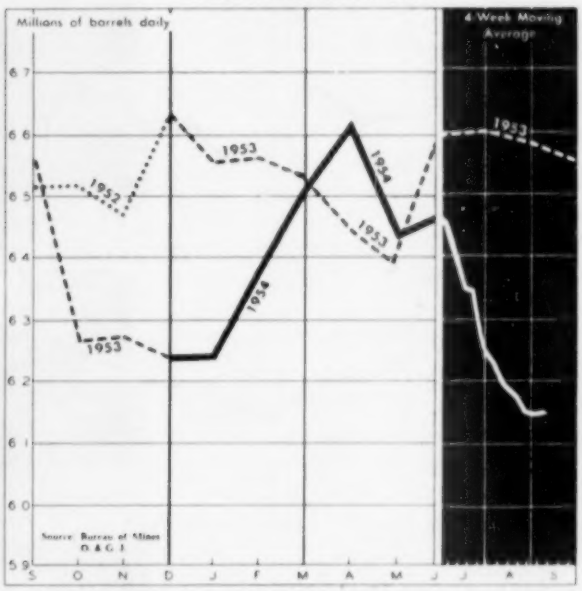
CRUDE IMPORTS



PRODUCT IMPORTS



CRUDE-OIL PRODUCTION

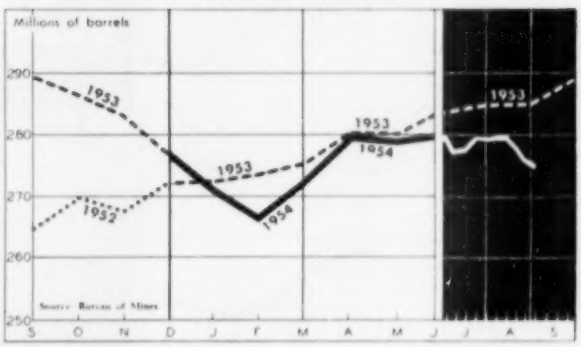


DAILY AVERAGE PRODUCTION FOR WEEK

	September 11			Sept. 4
	Crude oil	Lease condensate	Total	total
Alabama	4,000		4,000	3,900
Arkansas	77,000	500	77,500	77,100
California	965,500		965,500	971,700
Colorado	124,500		124,500	127,900
Eastern	55,200		55,200	55,200
Florida	1,500		1,500	1,550
Illinois	182,200		182,200	181,500
Indiana	27,900		27,900	28,300
Kansas	318,900		318,900	298,600
Kentucky	37,300		37,300	37,400
Louisiana	582,750	40,600	623,350	633,750
North	107,100	2,600	109,700	109,600
South	475,650	38,000	513,650	524,150
Michigan	30,500		30,500	30,100
Mississippi	87,100	3,400	90,500	90,200
Montana	42,300		42,300	39,700
Nebraska	18,900		18,900	18,600
New Mexico	205,000	1,650	206,650	207,275
Oklahoma	488,500		488,500	490,300
Texas	2,564,200	45,500	2,609,700	2,577,575
Dist. 1	41,900	400	42,300	41,900
Dist. 2	128,700	6,050	134,750	131,675
Dist. 3	404,000	22,200	426,200	423,900
Dist. 4	225,600	5,200	230,800	227,600
Dist. 5	43,500	350	43,850	43,000
Dist. 6	109,000	4,600	113,600	111,325
East Texas field	209,500		209,500	206,925
Dist. 7-B	134,000	25	134,025	128,875
Dist. 7-C	172,000	4,500	176,500	175,350
Dist. 8	831,000	1,900	832,900	823,175
Dist. 9	181,000	250	181,250	180,100
Dist. 10	84,000	25	84,025	83,750
Utah	4,100		4,100	3,600
Wyoming	251,700		251,700	245,800
North Dakota	‡14,100		‡14,100	‡14,300
Total U. S.	6,083,150	91,650	**6,174,800**	6,134,350
Change from previous week, up			**40,450**	
Canada	†230,575		†230,575	†274,425
Total U. S. production Jan. 1-Sept. 11			1,616,465,050 bbl.	
Same period last year (crude plus cond.)			*1,660,170,956 bbl	

*Includes 23,073,150 bbl. condensate. †Week ended previous Monday. ‡Inc. S.D. 200 bbl.

CRUDE-OIL STOCKS



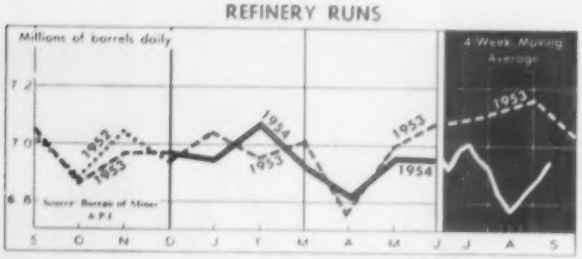
CRUDE-OIL STOCKS BY STATES OF ORIGIN*

(Thousands of barrels)

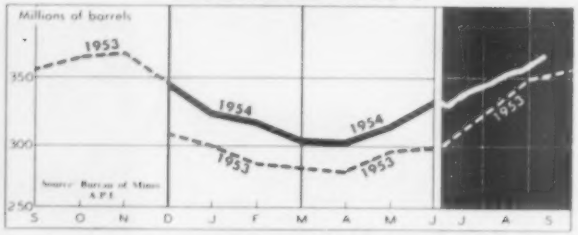
	Sept. 4, '54	Aug. 28, '54	Sept. 5, '53
Pennsylvania Grade	3,059	3,063	2,784
Other Appalachian	1,699	1,719	2,379
Illinois, Indiana, Michigan	12,548	11,873	12,236
Kansas	9,866	10,464	9,370
Oklahoma	24,456	26,732	29,638
Arkansas	3,214	3,192	2,851
Louisiana	15,861	16,987	17,248
North	2,574	2,430	2,809
Gulf	13,287	14,557	14,439
Mississippi	2,793	2,838	3,685
New Mexico	8,841	8,784	8,894
Texas	130,270	130,353	132,155
East Texas proper	11,016	10,988	11,028
West Texas	58,120	57,472	58,172
Texas Gulf	26,183	26,708	27,665
Other Texas	34,951	35,185	35,290
Wyoming	13,002	12,993	13,553
Other Rocky Mountain	5,193	4,788	2,837
California	33,314	33,029	32,851
Foreign	†10,721	9,670	10,746
Total	274,837	276,485	281,227

*Bureau of Mines. †Includes 3,224,000 bbl. in California.

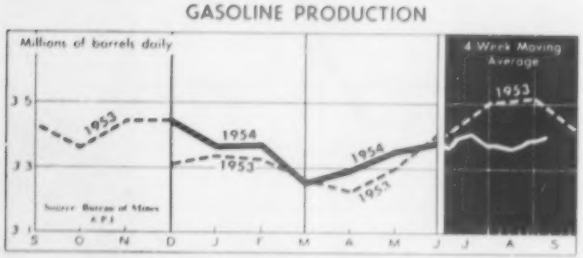
REFINERY RUNS



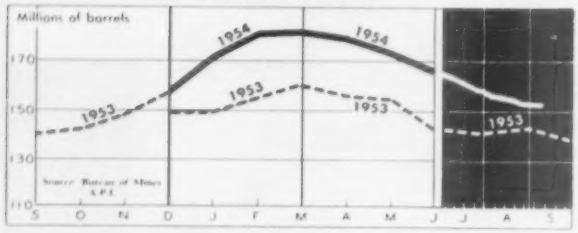
FOUR-PRODUCT STOCKS



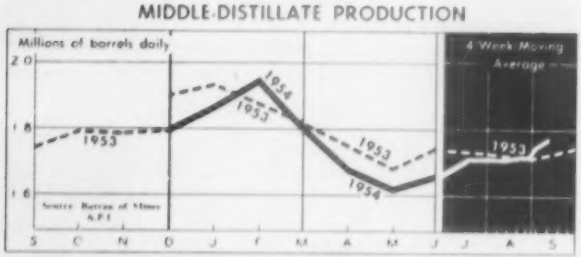
GASOLINE PRODUCTION



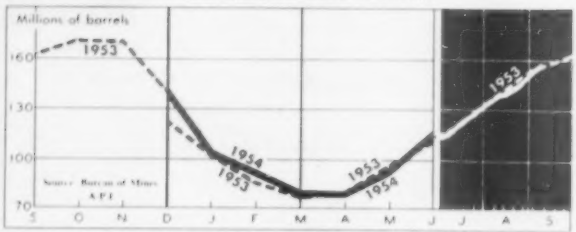
GASOLINE STOCKS



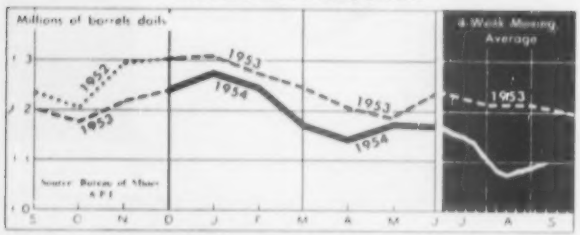
MIDDLE-DISTILLATE PRODUCTION



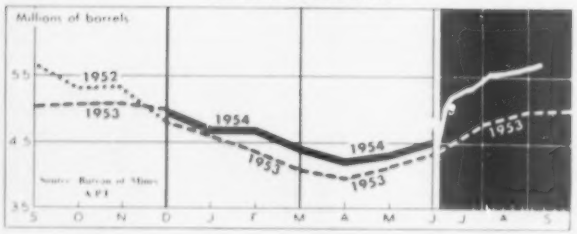
MIDDLE-DISTILLATE STOCKS



RESIDUAL PRODUCTION



RESIDUAL STOCKS



A.P.I. REFINERY REPORT, SEPTEMBER 10

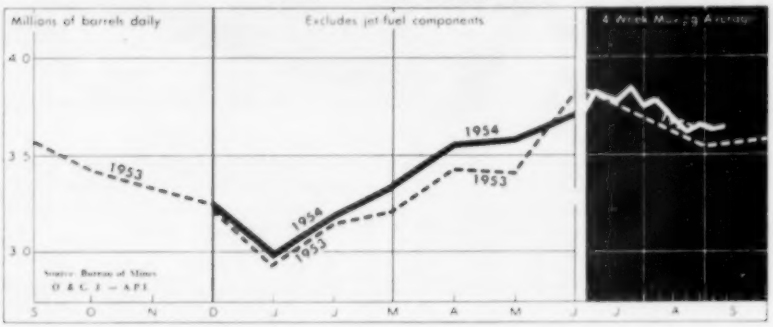
(Excludes all jet-fuel components)

(Thousands of barrels)

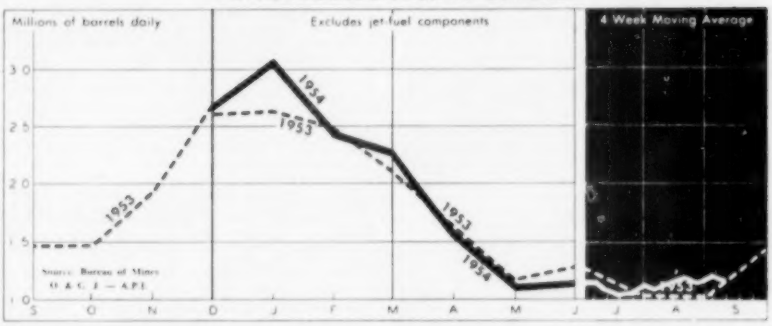
District—	Daily avg. runs	Daily average production—Gaso.*	Kero.	Dist.	Resid.	Stocks‡—Gaso.†	Kero.	Dist.	Resid.	Bureau of Mines, September 1953—Daily avg. runs	Daily average production—Gaso.*	Kero.	Dist.	Resid.
East Coast	1,017	440.3	36.4	254.6	193.3	33,766	14,331	43,082	11,562	1,052	420.8	35.2	249.6	227.9
Appalachian:														
District 1	113	49.3	7.3	19.3	12.0	4,078	678	2,003	514	107	46.1	5.0	20.4	11.3
District 2	64	34.1	3.6	9.4	5.7	2,242	441	729	299	85	48.5	5.3	12.6	11.1
Ind., Ill., Ky.	1,256	675.0	88.0	235.1	148.6	34,946	9,622	24,913	4,757	1,278	717.1	71.3	218.9	166.7
Okla., Kans., Mo.	611	332.1	15.3	133.4	39.9	14,819	2,319	13,128	1,151	583	353.9	17.7	134.9	45.0
Inland Texas	233	172.3	9.0	43.7	21.3	5,542	389	2,259	1,283	239	179.8	10.4	44.4	29.9
Texas Gulf Coast	1,732	809.6	121.8	369.1	237.0	20,694	4,405	13,801	6,605	1,691	835.3	118.3	398.1	238.8
La. Gulf Coast	573	296.4	55.6	154.9	45.1	8,512	2,796	4,951	1,467	546	280.9	51.1	138.9	43.2
N. La. and Ark.	83	33.1	7.6	21.3	5.6	3,985	1,113	1,065	126	86	35.9	6.8	19.1	6.4
Rocky Mountain:														
New Mexico	19	12.0	0.6	2.9	2.9	251	——	86	35	18	11.3	.4	3.0	2.9
Other Rocky Mt.	263	121.9	5.1	63.9	38.8	6,129	266	2,734	814	259	125.3	3.3	54.8	42.0
California	1,025	443.9	1.3	134.7	352.4	18,315	357	12,983	28,112	1,079	466.3	5.1	153.1	378.1
Sept. 10, 1954	6,989	3,420.0	351.6	1,442.3	1,102.6	153,279	36,717	121,734	56,725	7,023	3,521.2	329.9	1,447.8	1,203.3
Sept. 3, 1954	6,946	3,407.1	372.1	1,430.1	1,081.0	153,497	35,364	117,458	56,194					
Sept. 12, 1953	7,216	3,461.1	295.1	1,452.0	1,259.4	141,488	36,249	125,330	51,760					

*At refineries including natural blended. †Finished and unfinished. ‡At refineries, bulk terminals, in transit, and in pipelines.

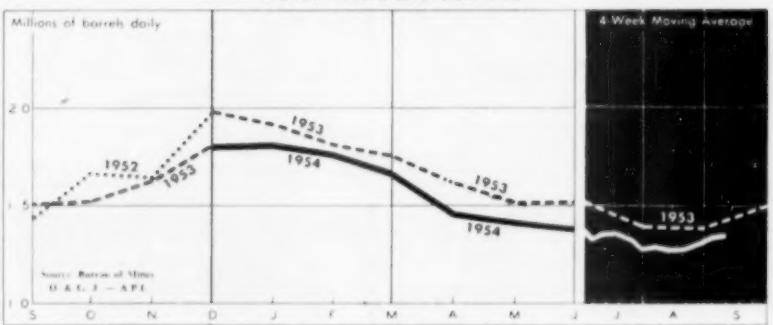
TOTAL GASOLINE DEMAND


Millions of barrels daily
Excludes jet fuel components
4 Week Moving Average
1953
1954
Source: Bureau of Mines
O A C J — API
S O N D J F M A M J J A S

TOTAL MIDDLE-DISTILLATE DEMAND


Millions of barrels daily
Excludes jet fuel components
4 Week Moving Average
1953
1954
Source: Bureau of Mines
O A C J — API
S O N D J F M A M J J A S

TOTAL RESIDUAL DEMAND



REPRESENTATIVE QUOTATIONS

Spot-market quotations of leading suppliers as of September 15, 1954. Prices are in cents per gallon, except for residual in dollars per barrel and wax in cents per pound.

GASOLINE, KEROSINE, AND FUEL OILS

	Mid-Continent Group 3	New York Harbor (barge)	Texas Gulf Coast
Regular gasoline	10.25-11	11.25-12	10.50-10.75
Premium gasoline	11.25-12	13-13.75	11.50-11.75
42-44 w.w. kerosine	9-9.25	9.70-9.95	8.75-9
No. 2 straw fuel oil	8.25-8.5	8.95-9.2	8.25-8.5
No. 6 residual	$1.20-1.25	$2.10-2.25	$1.85-1.95

NATURAL GASOLINE

	Group 3	North Texas	N. La.
Grade 26-70	5.0	4.5	4.75
Grade 18-55	6.0	5.5	5.75

LUBRICATING OILS

Mid-Continent

150-160 vis., D bright stock, 0-10 pp.	18
200 vis., No. 3 neutral, 0-10 pp.	13.25

WAX

Mid-Continent

132-134 A.M.P.	6.0

• Product markets at the middle of September were caught between decreased gasoline demand at the end of the motoring season and slow movement of heating oils. Delayed buying of distillates in September will mean larger sales later in the year.

PRODUCTION AND DEMAND—MAJOR PRODUCTS

(Thousands of barrels daily)

	Refinery prod.	Total demand
Gasoline:		
Four weeks ended 9-11-54	3,403	3,635
June 1954	3,379	3,894
August 1953	3,517	3,544
September 1953	3,432	3,579
Middle distillate:		
Four weeks ended 9-11-54	1,779	1,173
June 1954	1,705	1,159
August 1953	1,724	1,031
September 1953	1,745	1,453
Residual fuel:		
Four weeks ended 9-11-54	1,100	1,367
June 1954	1,123	1,349
August 1953	1,222	1,411
September 1953	1,203	1,498

CRUDE PRICES GRAVITY SCHEDULE

	Signal Hill, Calif.*	Oklahoma, Kansas	Gulf Coast Tex.†	West Tex.‡
14-14.9	$1.87			
15-15.9	1.93			
16-16.9	1.99			
17-17.9	2.05			
18-18.9	2.11			
19-19.9	2.18			
20-20.9	2.24	$2.50		$2.37
21-21.9	2.30	2.52		2.39
22-22.9	2.37	2.54		2.41
23-23.9	2.45	2.56		2.43
24-24.9	2.53	2.58	$2.91	2.45
25-25.9	2.61	2.60	2.93	2.47
26-26.9	2.69	2.62	2.95	2.49
27-27.9	2.76	2.64	2.97	2.51
28-28.9	2.83	2.66	2.99	2.53
29-29.9	2.91	2.68	3.01	2.55
30-30.9	2.97	2.70	3.03	2.57
31-31.9	3.04	2.72	3.05	2.59
32-32.9	3.12	2.74	3.07	2.61
33-33.9		2.76	3.09	2.63
34-34.9		2.78	3.11	2.65
35-35.9		2.80	3.13	2.67
36-36.9		2.82	3.15	2.69
37-37.9		2.84	3.17	2.71
38-38.9		2.86	3.19	2.73
39-39.9		2.88	3.21	2.75
40 and above		2.90	3.23	2.77

*Standard Oil Co. of California. †Upper Texas Gulf Coast. ‡Includes New Mexico Permian.

Effective dates: California, February 16, 1953; east of California, June 15, 1953; Pennsylvania Grade, September 1, 1954.

FLAT CRUDE PRICES

Representative posted schedules per barrel.

Louisiana:	
Cotton Valley (distillate)	$3.00
Cotton Valley (Holloway crude)	2.95
Texas:	
East Texas	2.90
Chapel Hill	2.83
Conroe	3.13
Van	2.73
Pennsylvania Grade:	
Bradford	3.00-3.23
Middle District	3.15
Southwest Pennsylvania	2.81
West Virginia	2.70
Ohio	2.74
Illinois Basin	2.90-3.02

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WELL DRILLING EQUIPMENT. New and used spudders, rotaries, core drills. Tools, pipe, cable. Everything for well drilling. Fishing tools rented. Pressey & Son, Pueblo, Colo.

WILSON ATLAS. Sales Price—$21,000.00. Equipped with two L1-600 Cummins Diesel Engines in good condition: includes pump drive, 12 PD groove sheave and V-belts. One American cathead and one plain spool cathead. Compound enclosed oil-bath. Includes one 1000 gal. fuel tank. Contact Cardwell, Houston.

Stop Tong Breakage!
ARMITE DRILL COLLAR & TOOL JOINT COMPOUND
ARMITE LABS., 6609 Broad St., Los Angeles 1, Calif
Petro. Industries Consultants, C.A. Caracas, Venez.

SAVE MONEY on 8" Line Pipe

Lapweld 8⅝" O.D. 28.55#

Very good #1 grade, used pipe. Straight 20' single random lengths, machine cleaned.

Choice of plain end bevelled for welding, or screw end threaded and collared.

Ideal for oil, water and gas systems, 850 to 900 psi.

Pipe located in Illinois, with low barge, rail and water rates to any part of the world.

Can ship unlimited quantities, at guaranteed rate of 28,000 feet per day.

Priced below market, selling at almost ½ cost of equivalent new pipe.

Will sell for cash, or will finance meritorious propositions.

Brokers and agents protected.

REDNEB PIPE CO.
P. O. Box 1798 Shreveport, La.
Phone 2-3276

FOR SALE EQUIPMENT

NEW. For Sale: 85, 4" o.d. seamless couplings. 8 rd thread, 5¾" long. Weight 6½ lbs., $4. each. M. J. Regan Pipe Co., Coffeyville, Kan.

FOR SALE: Sullivan 200 complete with all tools ready to work. Located Tulsa, Okla. Contact R. F. Mesker, Phone 6-0057 or 5-9357, Tulsa.

FOR SALE: ENGINE—165 Hp. Climax Model R61, maximum continuous Hp. rating 126. Herndon Drilling Company, 421 Mayo Building, Tulsa. Phone 4-9700.

FOR SALE

VALVES

A complete line of reconditioned & tested steel & cast iron

GATE VALVES

"Like new" performance. Guaranteed at substantial savings.

Hudson Pipe & Supply Co.
Ft. of E. 33rd St.
Bayonne, New Jersey
Federal 9-1811

FOR SALE

INGERSOLL-RAND
GAS ENGINE DRIVEN COMPRESSOR

1— XVG-8 —350 H.P.

Now equipped with LP compressor cylinders. In daily operation in large industrial plant to be electrified.

Excellent Condition
Low Price

EARL E. KNOX COMPANY
TELEPHONE: 2-5204
BACON STREET, ERIE, PA.

FOR SALE EQUIPMENT

SALES and rentals of cable drilling and fishing tools, casing and equipment, from the Southwest's largest stock of used cable tools and oil field supplies. Degen Pipe and Supply Co., Tulsa, Oklahoma.

THREE #12 Sweetland Filters, 48 bronze leaves, monel covered, on 3" C.C., now located in southwest, available for inspection. 11 Sperry 18" x 18" cast iron Filter presses, 11 chambers. Consolidated Products Co. Inc. #65 Garden Street, Hoboken, N. J. N. Y. Tel.: BArclay 7-0600.

FOR SALE—TD-18 International Dozer with 12' blade. Good condition and ready to go. Located near Artesia, New Mexico. $5,000.00. Contact Maico Pipeline Company, Inc., Attention, F. E. Smith, Box 660, Roswell, New Mexico.

ONE MODEL K Cardwell Spudder, fully equipped, excellent condition, operating in tri-state area. For further information write Box H-263, The Oil and Gas Journal, Tulsa, Oklahoma.

Gaso Duplex 4½" x 6" Power Pumps with Chrysler C-36 Engines, skid mounted, immediate delivery. Also Byron Jackson, Carter Centrifugal Units. Westinghouse 20-25-50 KW Generating Units.

H. H. COFFIELD
Attn.: W. H. ORR
Phones: 132—Rockdale, Texas
AT-3427—Houston, Texas

GASOLINE PLANT *FOR SALE*

Gasoline Plant, located in Brazoria County, Texas, shut down in January, 1954. Had been processing approximately thirty-three million feet of gas daily with absorber pressure approximately six hundred thirty pounds. Plant recovered Propane, Butane, Gasoline, Kerosene and Diesel Oil. Adequate storage tanks for all products. Drum Lead Blending Plant. Detailed inventory available upon request.

SOUTHERN PRODUCTION CO., INC.
P. O. Box 670, Ft. Worth, Texas

FOR SALE
EMSCO GB 800 RIG

This rig fully equipped with many extras. Less than 45,000' of hole drilled with rig and accessories since new. Inventory includes grooved drum, dynamatic brake, heavy duty mast, 12 foot substructure, 2 pumps including Gardner-Denver 800 H.P. GXR, 3 LRDU Waukesha Diesel Engines, Steel Mud Tanks, 4½" Grade E Hand Banded Drill Pipe, 6¼" and 7¾" Drill Collars. This rig is priced right. For details contact

BOX H-307, THE OIL AND GAS JOURNAL,
Tulsa, Oklahoma

FOR SALE EQUIPMENT

FRANKS MODEL 5000 Spudder — Serial No. 866. Sales Price—$7,500. Equipped with one Cummins HB1-600 Engine in good condition. Brake Rims in fair condition; Brake blocks—Good. General appearance—Good. Chains—Good. Basic Machine equipped with Spudding attachment, Skid and 65' Double Leg Pipe Mast with 8⅝" and 7" Pipe Legs; 4-Sheave Crown of Wilson Manufacture. Price includes Mast Guy Lines. Location of Unit — Western Kansas. Contact Cardwell, Wichita.

ROTARY RIG COMPLETE: 2,500 to 5,000 ft. capacity. Easily Portable. 4½-in. drill pipe. Double derrick, 7-ft. substructure, Model "S" Cardwell drawworks, 14-in. Gardner-Denver pump powered by LRO Waukesha. Located near Sterling, Colo. R. V. Dillard. Phone 1177 or write Box 992, Duncan, Okla.

PAIR SURPLUS 1879 Buda engines completely overhauled since use, each equipped with Twin Disc 27-inch hydraulic couplings. Engines located Wolf Trucking yard, Edmond, Okla. Price for pair, $7,000.00. Chester H. Westfall, Phone 4-3144, Tulsa.

COMPLETE RIG: New U-15 Drawworks with four 250 Horse Power Cummins diesel engines through hydraulic couplings, hydromatic brakes on 127-foot 450,000-lb. Lee C. Moore mast and substructure, 8,000 Ft. 4½" Drill Pipe, 14 new 7" O.D. x 27⅛" Bore Drill Collars, new Emsco D-500 7½" x 16" pump, new Cameron twin hydraulic BOP, and all accessories. Good condition. Now drilling 8,000-foot well in Rocky Mountain area. Inventory on request. Box H-403, The Oil and Gas Journal, Tulsa, Oklahoma.

GASOLENE PLANT
FOR SALE

Our Arkansas City, Kansas, Gasolene Plant is available for purchase and removal by January 1, 1955. Inventory and price upon request.

Cities Service Oil Company

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FULL FACTS, 8" x 10" PHOTOS AIRMAILED ON REQUEST, CALL LOUISVILLE—WABASH 6803

EQUIPMENT BUYS

TD18A TRACTOR-DOZER-WINCH—International Diesel, Ser. #TDR23636, equipped with Ateco straight dozer and hyd. pump, 22" grouser tracks, crankcase guard. Final drive seals replaced, master clutch relined, 5 bottom rollers rebushed. Cleaned and painted. Excellent machine priced less than ½ of new price.
f.o.b. Jasper, Ind. $6,750.00

D318 ELECTRIC SET—Caterpillar, Ser. #3V5028. A self regulating 45KW, 220-440 volt, 3 phase 60 cycle generator powered by Caterpillar Diesel 6 cylinder D318 engine. Has base, fuel tank, safety shut off device, radiator. In A-1 mechanical condition. A bargain.
f.o.b. Louisville, Ky. $2,100.00

D17000 ELECTRIC SET—Caterpillar Diesel, Ser. #3S1409SP. A 220-440 volt A.C., 60 cycle, 85KW generator which is powered by 8 cylinder Caterpillar D17000 Diesel engine. Complete with steel channel base and radiator. Sells new for $12,465.00. Special price.
f.o.b. Bowling Green, Ky. $5,400.00

WHAYNE SUPPLY CO.

800 W. MAIN ST.—LOUISVILLE, KY.
ASHLAND, KY. • BOWLING GREEN, KY.
PADUCAH, KY. • EVANSVILLE, IND.

FOR SALE EQUIPMENT

FOR SALE: Hopper Blitz Rig 4,000 feet capacity—Bender Mast—G.M. Diesel powered—completely portable with tools, drill pipe. Krug Exploration and Drilling Co., P. O. Box 53, Station B, Bakersfield, Calif. Phone—Fairview 3-3529.

WILSON GIANT—Serial No. 6383. Sales Price—$6,000. Equipped with Two Waukesha 145 GK Engines in good condition. General Appearance—Fair. Rig used for Work-Over. Price includes Kelco Spinning and Foster Breakout Catheads; Stromberg - McCreary Air Starters on Engines. Brakes circulating water-cooled; Manual Friction Clutches in Transmission; Others — Jaw Clutches. Rig has Slush Pump Drive and Rotary Drive Location of Unit—Lake Charles, Louisiana Contact Cardwell, Houston.

1—MODEL RL 3-Drum Cardwell Powered with Buda Model 844D Diesel Engine. Rig and Engine in Perfect Condition. 1-87' 2-Pole Mast. Box H-404, The Oil and Gas Journal, Tulsa, Oklahoma.

FAILING MODEL 55 portable drill. Capable 2500 ft. drilling. Rig and pump powered with GMC diesels. Complete rig, including drill pipe, dog house, fuel tank, and operating tools. Now operating in eastern Kansas. M & G Drilling Co., 1102 East St., Iola, Kansas.

U-15 WITH hydromatic brakes, powered by four 250 Horse Power Cummins diesel engines through hydraulic couplings with 127' Lee C. Moore mast, 4½" drill pipe, 6¼" drill collars. Oilwell 14P pump, mechanical Shaffer double BOP and all accessories for complete rig. First class operating condition. Rocky Mountains. Inventory on request, Box H-405, The Oil and Gas Journal, Tulsa, Oklahoma.

MODEL RL CARDWELL Three Drum Spudder, 65' Double leg mast reinforced for trunnion mount, heavy sub frame, powered by model 145 GK Waukesha Engine with combination natural gasoline, butane fuel system and fireproofing equipment. Also equipped with Wire Lines, Dog House, Light Plant and Tools ready to operate. Excellent Condition. 36L Type EB Bucyrus rig, Late Type, equipped with 145 GK Waukesha Engine, Wire Lines, Dog House, Light Plant and Tools, ready to operate. These rigs can be seen working in West Texas. Contact by phone, Midland, Texas, 2-4743 or write Route 1, Box 47C.

WANT EQUIPMENT: Did you find the equipment you wish to purchase in this column? If not, use an "Equipment Wanted" classified advertisement to find it. It is available somewhere and Journal classified advertisements will find it. See box heading for classified rates, or write The Oil and Gas Journal.

NEW STEEL PIPE
Below Mill Price

7" O.D.	.317 wall	200 feet
8⅝" O.D.	.352 wall	500 feet
9⅝" O.D.	.385 wall	2000 feet
12¾" O.D.	.250 wall	800 feet
16" O.D.	.375 wall	1460 feet
20" O.D.	.250 wall	1000 feet
20" O.D.	.281 wall	1300 feet
24" O.D.	.281 wall	720 feet
24" O.D.	.406 wall	920 feet
26" O.D.	.281 wall	1100 feet
26" O.D.	.312 wall	820 feet
26" O.D.	.500 wall	120 feet

All 40 foot lengths
Special Low Price for Immediate Delivery

Special Sale
RECONDITIONED PIPE
8⅝" O.D. 28.55 lbs. per ft.
72,000 feet
12¾" ft. O.D. 49.56 lbs. per ft.
16,000 feet
Machine Cleaned - Beveled Ends
20 ft. random lengths

Write - Wire - Phone
SONKEN-GALAMBA CORP.
2nd and Riverview (X-128)
Kansas City 18, Kansas
ATwater 9305

FOR SALE EQUIPMENT

FIVE TYPE 80 COOPER Gas-Engine compressors. Thirty 20-in. stroke compressor cylinders—size 5½ in. to 26 in. Pressures to 1,000 lbs. W. S. Smith, 205 Thompson Bldg., Tulsa, Okla.

FOR SALE: Model "K" Cardwell tubing and rod unit complete with tubing and rod tools, mast, mounted on Ford tandem truck. Melco Drilling Company, Seminole, Oklahoma.

20,000' 2¼" o.d. seamless line PE 20' random lengths, good as new. A smart buy at 18c. M. J. Regan Pipe Co., Coffeyville, Kan.

USED EQUIPMENT

Model E Allis-Chalmers Skid Unit mounted on International Truck. Located Great Bend, Kansas.
Franks 7000 Single Drum Skid Swabbing Unit mounted on Dodge Tandem Truck. Located Odessa, Texas.
Franks SAL 4500 Skid Rotary Rig Cummins Power, 96' Derrick. Located, Tulsa, Oklahoma.

O.C.S. Type 3 Servicing Unit mounted on 1942 Mack Truck. Located Odessa, Texas.
Franks Super Senior Well Servicing unit 8 x 10 x 62 Single Pole Mast mounted on Tandem International Truck, Located Seminole, Oklahoma.
Write, wire or call Franks Mfg. Corporation, Box 3218, Whittier Station, Tulsa, Oklahoma.

EQUIPMENT WANTED

WE WANT TO BUY—1—4" stationary head for old style 4" Landis Machine. W. H. Greer Supply Co., Owensboro, Ky.

WE WANT TO BUY—Treated Crude Oil Tank Bottoms. Box H-428, The Oil and Gas Journal, Tulsa, Oklahoma.

WANTED: 1— SIE PSU-11 amplifier unit with 12 type GA-11 amplifiers and 1 type PIC-11 input checking panel. Advise condition and price. Box H-426, The Oil and Gas Journal, Tulsa, Oklahoma.

WILL PAY highest prices for used casing, used line pipe, abandoned leases, or other surplus lease equipment. Your idle producing equipment is worth dollars. Green Pipe & Supply Co., Box 1383, Tulsa, Oklahoma.

EQUIPMENT NOT IN USE: Did you find a buyer in this column for the equipment you have for sale. Someone wants it and an "Equipment For Sale" classified advertisement in the Journal will find a buyer. See box heading for classified rates or write The Oil and Gas Journal.

WANTED
Used API Bolted Steel Tanks
Contact—
NORMAN STRAUSS
Brown-Strauss Corporation
1546 Guinotte Avenue
KANSAS CITY, MISSOURI

WANTED
Crude Oil Tank Bottoms and Unmarketable Low Gravity Crude
Contact—
RAY M. CODER
Chanute Refining Company
CHANUTE, KANSAS

HELP WANTED

REFINERY MAINTENANCE SUPERVISOR. Under 45. Graduate Engineer preferred. Salary to $10,000. Must have good refinery maintenance experience. Our fee paid. All replies confidential. Send complete resume to CHAS. J. LOVELESS PERSONNEL SERVICE, 616 S. Main, Tulsa, Oklahoma. Phone 4-3193.

HELP WANTED

FOREIGN EMPLOYMENT. List of oil companies and drilling contractors showing where to apply for foreign jobs. OIML Co., Box 2603, Tulsa, Okla. $5.00 cash.

TRAINING SUPERVISOR. Excellent opportunity in Rocky Mountain Area. Must be experienced in this work, under 30, college graduate preferred. Salary to $500. All replies confidential. Send complete resume to CHAS. J. LOVELESS PERSONNEL SERVICE, 616 S. Main, Tulsa, Oklahoma. Phone 4-3193.

PROCESS ENGINEERS

Chemical Engineers with advanced degrees required for process design and evaluation work. Minimum five years' experience in process design petroleum or organic chemical facilities required. Send complete resume. Box H-420, The Oil and Gas Journal, Tulsa, Oklahoma.

EXPLORATION MANAGER

Independent oil company has opening for experienced Exploration Manager, to direct land and geological activities in Mid-Continent and Rocky Mountain Areas. Must be capable of handling all phases of land and geological operations, originating and closing deals, between ages of 30 to 40, with major oil company training preferred. Unlimited opportunity for person qualified. In replying give past employment record, educational background, and complete personal data. Box H-414, The Oil and Gas Journal, Tulsa, Oklahoma.

PETROLEUM ENGINEERS

Experienced graduate engineers or recent graduates, for immediate and future job openings in Saudi-Arabia and New York City. For engineering work in development, production, drilling, process, and oil and gas engineering on primary and secondary recovery problems.

Salaries commensurate with education and experience. Write giving full particulars regarding personal history and work experience. Please include telephone number.

Recruiting Supervisor, Box 79

ARABIAN AMERICAN OIL COMPANY
505 Park Avenue
New York 22, N. Y.

GASOLINE PLANT OPERATORS

Experienced gasoline plant operators needed by substantial independent. Location Central West Texas. Company new and expanding. Liberal insurance, vacation, and other benefits. When replying give age, experience, availability.

BOX H-425,
THE OIL AND GAS JOURNAL,
TULSA, OKLAHOMA

SERVICE OPERATOR

Major processing company serving the petroleum refining industry needs service operator. Man must be willing to travel. College education preferred.

BOX H-401,
THE OIL AND GAS JOURNAL,
TULSA, OKLAHOMA.

HELP WANTED

MUD PUMP DESIGN Engineer with experience to develop line of pumps for Drilling Rigs. Please give record of education and experience and salary expected. Box H-427, The Oil and Gas Journal, Tulsa, Oklahoma.

CHEMICAL ENGINEER—with 2-4 years technical experience in petroleum refinery operations. Position in research and engineering department of chemical company in midwest area. Work invloves petroleum refining and fuel manufacturing relationships. Box H-372, The Oil and Gas Journal, Tulsa, Oklahoma.

WANTED FOR EMPLOYMENT

Petroleum Engineer, preferably recent graduate for Louisiana Gulf Coast work. Duties to require assistance in preparation of reservoir studies, evaluation and routine engineering reports. Work located in New Orleans with reliable and financially strong concern. Reply giving age, previous experience, if any, military status, and salary desired. Inquiries will be kept strictly confidential. Our employees know of this ad. Box H-381, The Oil and Gas Journal, Tulsa, Oklahoma.

WANTED: Distributor for Gas Lift Equipment in West Texas. Preferably Engineering or sales organization now operating in West Texas. Commission far above average. Macco Oil Tool Co. Inc., P. O. Box 7288, Houston 8, Texas.

ENGINEERS, Executives, Technical Men. Salaried positions—$6,000 to $30,000. This confidential service for outstanding men who desire a change of connection. Will develop and conduct preliminary negotiations without risk to present position. Send name and address for details. Tomsett Associates, 434 Frick Bldg., Pittsburgh 19, Pa.

GEOLOGIST—Senior Research, to work in New York. Applicant should have advanced degree and broad experience in petroleum geology, foreign and domestic. Work involves compilation of geological data, evaluation of foreign petroleum prospects and preparation of reports. Important petroleum organization offers this position of responsibility and appeal to the right party. Pay commensurate with education and experience. Age range, preferably 35 to 50. Submit resume in detail. Box H-417, The Oil and Gas Journal, Tulsa, Oklahoma.

THE RIGHT MAN: Can you fill the position you have open from the qualifications listed in this column. Men are always looking for an opportunity to improve themselves. Use a "Help Wanted" Journal classified advertisement to find the men you need. See box heading for classified rates or write The Oil and Gas Journal.

WANTED: Manufacturers representatives with good following calling on Oil Producers and Supply Stores to represent Manufacturer of the Hunter Flex-Seal oil well pump plunger and packing means for same. Wants Commission Sales Representatives for following territories: Kansas, Arkansas and North Louisiana, East Texas, West Texas, and California. Please give details concerning present Sales Coverage first letter. All replies confidential. W. H. Hunter Engineering Company, 150 Marlborough Dr., Pontiac 19, Michigan.

MECHANICAL DESIGN ENGINEERS

EMPLOYMENT OPPORTUNITIES

in

SOUTH AMERICA

Attractive staff positions available with affiliates of STANDARD OIL COMPANY (N. J.). Engineering degree and 3-5 years oil refinery or chemical plant design experience required.

Liberal salaries and benefits.

WRITE

giving age, education, marital status and detailed experience resume.

BOX 398-A
RADIO CITY STATION
NEW YORK 19, N. Y.

SITUATIONS WANTED

SALES MANAGER or other executive position wanted, with opportunity to purchase stock, in oilfield Sales and Service or Specialty firm. Now owner of similar small business, can transfer present accounts to new company on mutually profitable basis. Experienced, excellent background, extensive oil industry contacts. Only attractive proposition by reliable firm considered, preferably Houston or Gulf Coast location. Box H-395, The Oil and Gas Journal, Tulsa, Oklahoma.

PETROLEUM ENGINEER—5 years excellent experience drilling, production, waterflooding, unitization, property valuation in Mid-Continent. Presently employed. Desires job with sound aggressive independent. Locate anywhere. Box H-416, The Oil and Gas Journal, Tulsa, Oklahoma.

DRAFTSMAN, 3 years experience Seismograph Surveyor. References. Two years College. Desires permanent location. Box H-396, The Oil and Gas Journal, Tulsa, Oklahoma.

SALES ENGINEER. Interested in a connection with a progressive company which does not require excessive travel; experience includes introduction of new processes; presently located at Wichita Falls, Texas, will relocate for the right deal; has wide acquaintance in oil industry and related fields. Box H-413, The Oil and Gas Journal, Tulsa, Oklahoma.

ATTENTION: Independent Producers. Has the gas or natural gasoline aspect of your business grown until it needs experienced attention? Graduate Engineer, forty-two years of age with broad experience in gas-gasoline phase desires connection with progressive company. Experience includes production, design, construction, and operation of gas-gasoline plants including purchase and sales contracts. Box H-412, The Oil and Gas Journal, Tulsa, Oklahoma.

GEOLOGIST, 32, degree, 3½ years U. S. Latin America experience, desires subsurface position. Foreign or domestic. Speak Spanish. Box H-429, The Oil and Gas Journal, Tulsa, Oklahoma.

GEOLOGIST - GEOPHYSICIST. 36, Married, degree in geology, 14 years of interpretation and supervisory experience, desires position in permanent location. Box H-418, The Oil and Gas Journal, Tulsa, Oklahoma.

GEOLOGIST: Single, 29 years old, B.S. degree plus some graduate studies, 18 months geological well site logging; 18 months in geophysics. Desire position in exploration geology—domestic or foreign. Box H-424, The Oil and Gas Journal, Tulsa, Oklahoma.

ATTORNEY, age 27, six years with legal departments of major and independent producing companies, desires responsible legal position with future. Experienced in contract negotiation and preparation (Private and Public Lands), title examination, tax work and litigation. Member of Texas Bar. Box H-419, The Oil and Gas Journal, Tulsa, Oklahoma.

THE POSITION YOU WANT: Oil Industry companies are looking for men to fill every conceivable kind of position. If you didn't find the position in this column that you are looking for, use a "Situation Wanted" classified advertisement to state your qualifications. Some company is probably looking for your ability. See box heading for classified rates or write The Oil and Gas Journal.

Well organized, well established oilwell drilling contractor desires the management and supervision of oil properties in West Texas, Central Texas, and New Mexico. Can provide complete handling of oil properties, from acquisition to production. No properties too small, and none too large to handle. Inquiries from independents, groups, small or medium sized oil companies invited. Write, wire, or call collect for further information.

MAKIN DRILLING COMPANY
P. O. Box 1628, Hobbs, New Mexico,
Phone 3-3141.

146 Allen Building, Midland, Texas,
Phone 2-2962.

BUSINESS SERVICE

Delaware Corporations formed and serviced, American Guaranty & Trust Company, P. O. Box 487, Wilmington, Delaware.

REAL ESTATE

REAL ESTATE

Available Office Space

Newly constructed, air conditioned fire-proof building with all modern conveniences, including ample parking space. Available about November 1, 1954.

Contact

GEM OIL COMPANY,
Box B, Brush, Colorado,
Tel.: 540

FOR SALE: Modern Air-Conditioned office building, suitable for medium size petroleum or allied firm. Equipment yard and garage with adequate parking facilities located in a desirable area of Tulsa. Box H-369, The Oil and Gas Journal, Tulsa, Oklahoma.

SPACE IS NEEDED: A Journal display classified advertisement is the quickest way to rent or sell your real estate. In the present period of expansion oil industry firms urgently need the space you have available. If it isn't listed here, you may also find it by stating your needs in these pages. For classified rates see box heading or write The Oil and Gas Journal.

FOR SALE

REAL ESTATE . . . 770 Lin. ft. Perdido Bay shore property in Baldwin County, Alabama, Gulf Coast, 18 mi. west of Pensacola, Florida.

Access to potential barge drilling areas in protected bay waters or open Gulf.

Also ideal site as barge line terminal or industrial plant.

Address **H. M. Tomkins,** 1625 Barrancas Avenue, Warrington, Florida.

WANTED

GEOLOGIST WANTS SET of old Oklahoma scout tickets. Primarily interested NE Oklahoma. Box H-380, The Oil and Gas Journal, Tulsa, Oklahoma.

GEOPHYSICAL SERVICE

EXPERIENCED ACCOMPLISHMENT of your required Exploration Mapping, Geological Investigations, appraisals of leased acreage and general co-ordinated representation in Central and Eastern Oklahoma. References exchanged. Paul M. Jameson, 1516 North Boston, Tulsa 6, Oklahoma, phone 3-1713.

STRIP LOG CABINETS

MORE LOGS ARE FILED in Kraftbilt Strip Log Cabinets than all others combined! Loaded drawers glide smoothly on roller bearings. Three drawers to section—add sections as needed. Built to last a lifetime! Send for Catalog 352-B. Ross-Martin Co. P. O. Box 800-A, Tulsa 1, Okla.

PRODUCTION WANTED

NEWLY ORGANIZED syndicate wants to buy 5,000 to 30,000 barrels oil monthly production. You will deal direct with principals. Prompt action. Evaluation report must accompany submittal. Box H-422, The Oil and Gas Journal, Tulsa, Oklahoma.

PRODUCTION WANTED

We will purchase any amount of settled production up to 500 barrels per day provided you control operations. Interested in Kay, Logan, Noble, Garfield, Payne, Pawnee, Creek, Okfuskee or Lincoln Counties. We are producers and operators and will furnish bank references if your proposition interests us. Would like full details with first letter.

BOX H-415,
THE OIL AND GAS JOURNAL,
TULSA, OKLAHOMA

ROYALTIES

WANTED: OIL PRODUCING ROYALTIES anywhere. Cash paid. Send full details, private or brokers. Traders Co., 9th & 1st, Rock Island, Ill.

WISH TO BUY producing royalties. Box H-379, The Oil and Gas Journal, Tulsa, Oklahoma.

JACK EAGLE, Oil Properties, 706 City Nat'l Bldg., Oklahoma City, Oklahoma. Telephone REgent 6-7027.

OFFERING CHOICE PRODUCING oil income royalties with large reserves per Dollar investments. A. S. Berry, 522 Wright Bldg Tulsa, Okla.

GET TOGETHER: Both Capital and Royalties are available. If the investment proposition you want isn't listed in this column, use a Journal classified advertisement to find it. See box heading for classified rates, or write The Oil and Gas Journal.

LEASE AND DRILLING BLOCKS

W½ OF SEC. 29, 13-102, Sweetwater Co., Wyo. $10.00 and 4%. Box H-430, The Oil and Gas Journal, Tulsa, Oklahoma.

RECENTLY ORGANIZED group seeking drilling deals accompanied by complete geological reports. Box H-423, The Oil and Gas Journal, Tulsa, Oklahoma.

$2250.00 drills, oversees, 920 ft. well, 120 OKLA. lease. Offsetting 6 Bbl. Natural well. Sixteenth override. Geologists report, maps, logs. Chas. Byron, 1071 York, Denver, Colo.

GOOD BARGAIN in override in Carter, Oklahoma field. Owner needs the money and will sell at good price for buyer. Have one tract smaller than other. Also, 200 acres near Carter shallow field for about 1600 feet. Half mile two staked wells. HURRY. Box H-421, The Oil and Gas Journal, Tulsa, Oklahoma.

15,000 ACRES, leased and open for drilling and development. Forrest City Basin Oil Trap. S.W. Iowa. Raymond A. Trygg, Ogden, Iowa.

Will pay cash instantly for lease (large blocks), royalties, mineral deeds, production. Write fully—P. O. Box 2153, Denver, Colorado.

MAKE ME A DEAL TO DRILL section 31, Tnsp. 19, Block 20, Anderson Co., Kansas. 275 Acres, considerable Acreage bordering C. W. Proctor. 3211 S. W. 9th, Des Moines, Iowa. Ph. 8-8156 or 4-7521.

LEASES ROYALTIES

Producing and Nonproducing
Bought and Sold—Any Area

Inquiries Invited

B. D. BUCKLEY
4835 Delmar Ave., St. Louis 5, Mo

FOR SALE

8 producing wells in Logan County, Kentucky and additional acreage with excellent possibilities for further development. 1953 income $6,449.27.

LAMEL CORPORATION
Marshall Building, Cleveland, Ohio,
MAin 1-5555

LEASE AND DRILLING BLOCKS

SEE A. L. BOWLES, Box 947, Ada, Okla. for drilling deals and producing royalties if you have the cash for Oil Investments.

WANT TO DRILL on proven acreage. Have some income tax money. Prefer Texas, Oklahoma or Illinois. Moderate depths only. Replies confidential. Box H-402, The Oil and Gas Journal, Tulsa, Oklahoma.

11 BILLION FEET of gas reserves in new shallow sand development. Property is presently marketing million feet per day. Detailed information available to qualified parties interested in making a deal. Box 2, Clarendon, Penna.

STATE & FEDERAL Oil & Gas leases, about 10,000 acres in DeBaco, Gudaleye and Lincoln Co., New Mexico. Will sell all in one block $2.50 per acre. Box H-410, The Oil and Gas Journal, Tulsa, Oklahoma.

LOOKING FOR A LEASE? There will be over 40,000 wells drilled this year. If you are looking for a lease, drilling block, or drilling deal and you haven't found it in this column, or if you have a lease or drilling block you want drilled, a Journal classified advertisement can find an interested party. See box heading for classified rates, or write The Oil and Gas Journal.

BUSINESS OPPORTUNITY

WILL GIVE AWAY MY BUSINESS to qualified oilfield sales and specialty firm. Houston area, in return for overriding commission. Have good oil industry customers, lack sales personnel. Box H-397, The Oil and Gas Journal, Tulsa, Oklahoma.

ELECTRIC LOG CABINETS

FOR ECONOMICAL FILING of full-size electric logs, most geologists prefer Kraftbilt E-24 4-drawer Electric Log Cabinet. Two compartments to each drawer with separate follow-blocks make this cabinet handy, economical. For filing reduced electric logs, geologists use Kraftbilt E-28 8-drawer cabinet. Send for Catalog 352-B. Ross-Martin Co. P.O. Box 800-A, Tulsa, Okla.

Equipment Men

Curtiss Joins S. M. Jones As Vice President

C. CURTISS, JR.

Colman Curtiss, Jr., Buffalo, N. Y., has joined the S. M. Jones Co. division of Buffalo-Eclipse Corp., Mason Jones, president, has announced. He will be a vice president of S. M. Jones succeeding the late Frank S. Oatman.

Curtiss has been with the Buffalo Bolt division of Buffalo-Eclipse Corp. for 20 years. He has been sales manager of the Buffalo concern, but will assume general administrative duties with S. M. Jones. He has a manufacturing background of production and accounting in addition to sales.

Byron Jackson Announces District Sales Changes

Byron Jackson Co. has opened a new office at Memphis, Tenn., according to a recent announcement. Robert

W. Pullen, sales engineer of Tulsa, was transferred to Memphis to open the new office.

In the Tulsa district, Phillip W. Risch, formerly district service engineer for the Mid-Continent territory, was promoted to sales engineer and Robert Damek has been transferred from Houston to the Tulsa office as district service engineer. E. R. Raguse is district manager in charge of the Tulsa office.

Carson-Wolf Will Build For Petroleum Industry

The Carson-Wolf Corp., has announced its formation to become constructors for the petroleum, natural-gas, and chemical industries, with offices in the Melrose Building, Houston, Tex.

The president and vice president of Carson - Wolf combine approximately 30 years of construction experience in the natural-gas industry, in the crude-oil and products-pipeline industry, and in the refining industry.

President O. L. (Kit) Carson is a mechanical engineer whose work in the petroleum industry covers superintendent of gasoline plants for the Waite

O. L. CARSON

WOLFINGER

Phillips and Independent Oil & Gas Co.'s of Tulsa, from 1925 through 1930. In 1930, he joined Panhandle Eastern Pipe Line Co., of Kansas City, Mo., as chief engineer. In 1935, he joined Fluor Corp., Ltd., of Los Angeles to establish a Gulf Coast division in Houston. In 1937, he was appointed chief engineer of the oil and gas producing division of the Phillips Petroleum Co. In 1941, he entered business as an engineering consultant with offices in Houston, and later he joined Graver Construction Co. as southern division manager in Houston. In 1948, he became general manager of Tellepsen Petro-Chem Constructors, which position he held until July of this year when he accepted the presidency of this corporation.

Paul F. Wolfinger, vice president, entered the construction field for the petroleum industry in 1940 as estimator for Manhattan Construction Co. In 1942 he became associated with Midwestern Constructors, Inc., as estimator in Tulsa office. He was later promoted to job superintendent for this firm. In 1946 he entered business under the name of Fulton Engineering Co. of Amarillo, Tex., as part-owner and general manager and built a large number of natural-gas-compressor stations and other types of installations. In 1950, he was made general construction superintendent for Tellepsen Petro-Chem Constructors. In 1953, he went back with Midwestern Constructors as southern division manager in Houston, the position he held until July 1 when he accepted the firm's vice presidency.

Welex Jet Makes Austin Sales Representative

J. C. AUSTIN

Jack C. Austin, former assistant manager of Wichita Falls Chamber of Commerce, has been appointed a special sales representative for Welex Jet Services, V. A. Brockman, Welex Wichita Falls district manager announced recently.

For the past year, Austin has been engaged in a drilling and production operation with a local independent oil operator. He is a member of the board of directors of North Texas Oil and Gas Association.

Bailey Meter Appoints Krusemark as Engineer

F. D. Krusemark of Bailey Meter Co., Cleveland, Ohio, manufacturers of industrial instruments and automatic control equipment, has been appointed a resident engineer, with headquarters in Dallas.

A subdivision of the Houston district office, the Dallas territory includes northern Texas and northwestern Louisiana.

Krusemark joined the company in 1946 as a member of the engineering class. In 1948 he was assigned to the Denver district office and was on the Denver staff until his present appointment.

LEGAL

Sealed bids for Oil and Gas Mining Leases on restricted Allotted lands of the Fort Berthold Indian Reservation, North Dakota, will be received at the Office of the Superintendent of said reservation, New Town, North Dakota until 2:00 P. M., Central Standard Time on September 28, 1954, and will be opened immediately thereafter in the presence of such bidders as may attend. Total allotted land is 16,581.33 acres. All of this land is located in McKenzie county, State of North Dakota. For additional information write the superintendent of the Fort Berthold Agency, New Town, North Dakota, or call the Agency Land Office, phone 74340, New Town. Ralph M. Shane, Superintendent.

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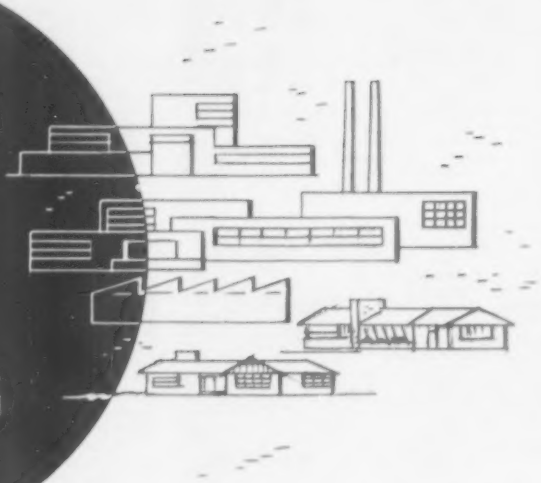

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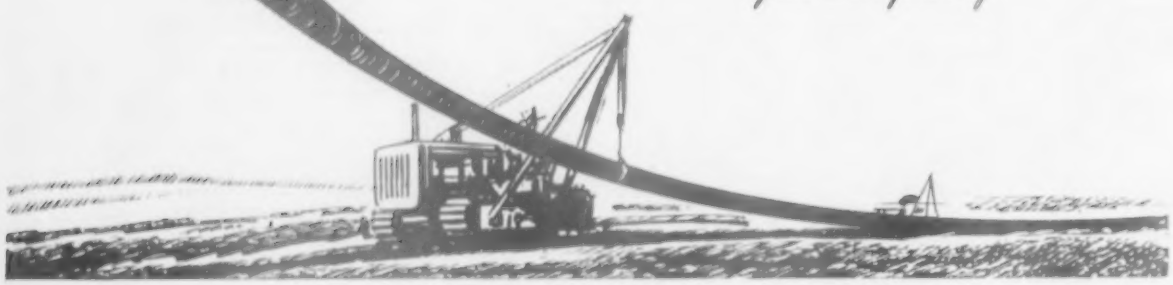

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